MER 93RD 2971

Instruction Manual

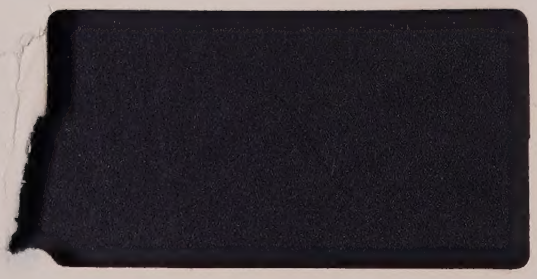
MODEL 9500A

RMS

DIGITAL VOLTMETER

FLUKE

ELECTRONICS FOR INDUSTRY
INSTRUMENTS / COMPONENTS



JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133

April, 1969

MODEL 9500A

RMS

DIGITAL VOLTMETER

9500A serial no. _____ and above.

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MODEL 9500A RMS DIGITAL VOLTMETER

SECTION I

INTRODUCTION AND SPECIFICATIONS

1-1. INTRODUCTION

1-2. The Fluke Model 9500A RMS Digital Voltmeter provides accurate true rms measurement of voltages from 0.001 to 1200 volts ac. Manual or automatic control features along with its high measurement accuracy makes this instrument suitable for not only laboratory and production applications but for system applications as well.

1-3. Since the instrument is an rms responding device instead of the average or peak responding, it is suitable for measurement and calibration of square, triangular, sawtooth and other non-sinusoidal waveforms. The instrument measures the true rms value of these waveforms regardless of the harmonic or phase variation in the harmonics.

1-4. The basic Model 9500A contains a front panel BNC input. However, optional features are available for the instrument and include a probe input, a rear panel BNC input, a 1-2-4-8 BCD digital output, and a 1-2-2-4 BCD digital output. These options are identified by corresponding -01 through -04 designations and may be installed in the combinations illustrated in Figure 1-1. Upon installation of either of the -03 or -04 options, remote control features are provided, enhancing the instrument compatibility for systems applications.

1-5. The instrument is entirely solid-state in design, with the exception of the readout tubes, and module plug-in construction is used throughout for ease of maintenance of the instrument. The instrument is equipped with resilient feet and a tilt-down bail for bench use or may be mounted in a standard 19 inch relay rack using the rack mounting brackets supplied with each instrument and Jonathan 120QD rack mounting slides.

1-6. ELECTRICAL SPECIFICATIONS

INPUT VOLTAGE RANGE
0.001 to 1100 volts rms in five ranges of 0.1, 1, 10, 100, 1000 volts rms, each with 20% over-ranging. Ranges can be selected automatically or manually. Remote control features are available with the installation of either the -03 or -04 option.

	01	02	03	04
01	SINGLE	NONE	BOTH	BOTH
02	NONE	SINGLE	BOTH	BOTH
03	BOTH	BOTH	SINGLE	NONE
04	BOTH	BOTH	NONE	SINGLE

Figure 1-1. AVAILABLE OPTION COMBINATIONS

FREQUENCY RANGE
20 Hz to 700 kHz.

ACCURACY
The basic accuracy specifications below apply at the nominal calibration temperature (23 ±1° C) to measurements between full over-range and 10% of full range. The instrument may be used between 10% of full range and 0.4% of full range on any range with reduced accuracy and limited frequency range.

10 mv to 500v	50 Hz to 10 kHz ±(0.05% of input + 0.015% of range) 10 kHz to 50 kHz ±(0.1% of input + 0.02% or range) 50 kHz to 100 kHz ±(0.3% of input + 0.02% of range)
500v to 1100v	50 Hz to 20 kHz ±0.15% of input 20 kHz to 50 kHz ±0.2% of input 50 kHz to 100 kHz ±0.5% of input
10 mv to 1100v	100 kHz to 200 kHz ±1% of input 200 kHz to 700 kHz *±5% of input

*The product of input voltage x times frequency should not exceed 1 x 10^8 volt-Hertz.

30 Hz to 50 Hz
±(0.3% of input + 0.02% of range)
20 Hz to 30 Hz
±1% of input

At frequencies between 20 and 30 Hz, the instrument readout will start to follow the input signal; however any reading obtained will be within the specified accuracy limits.

TEMPERATURE COEFFICIENT OF ACCURACY
(0° to 50° C)

50 Hz to 20 kHz	±0.004%/° C
30 Hz to 50 Hz	±0.005%/° C
30 kHz to 50 kHz	±0.005%/° C
20 Hz to 30 Hz	±0.01%/° C
50 kHz to 200 kHz	±0.01%/° C
200 kHz to 700 kHz	±0.03%/° C

DISPLAY
Four-digit neon in-line readout plus over-range, including an automatic decimal indication.

RESOLUTION
0.01% of range.

CREST FACTOR
10 (1500v peak).

INPUT IMPEDANCE

Model 9500A
1 megohm shunted by less than 25 pf.

Model 9500A-01 (with probe)
1 megohm shunted by less than 7 pf.

FLOATING IMPEDANCE
Greater than 10^8 ohms shunted by less than 2000 pf. May be floated up to 600 VDC or peak AC.

COMMON MODE REJECTION

BNC Input

Greater than 120 db at 60 Hz and below, decreasing 6 db per octave to 60 db at 60 kHz. Greater than 60 db above 60 kHz.

Probe Input

Greater than 80 db at 60 Hz and below, decreasing 6 db per octave to 20 db at 60 kHz. Greater than 20 db above 60 kHz.

RESPONSE TIME
3 seconds maximum within a range to settle within 0.1% of final reading. A maximum of 1 second additional is required for each range change in automatic ranging mode.

OVERLOAD PROTECTION
Fully protected from damage for any input up to 1100 volts rms or 1500 volts peak.

DISPLAY TIME SAMPLE RATE
Variable from 0.1 second to 10 seconds by front panel control in two ranges of 0.1 second to 2 seconds and 2 seconds to 10 seconds.

SELF-CALIBRATION
The self-calibration system may be actuated manually by a front panel pushbutton or may be actuated automatically after every other display period by operating the instrument in the 2-second to 10-second display time range.

DIGITAL OUTPUT
Printer options are available for providing 1-2-4-8 or 1-2-2-4 BCD outputs including range information at the rear connector.

Logic "1" = +13 ±0.5 volt dc with 10 kilohm source resistance.

Logic "0" = +0.5 ±0.5 volts dc with less than 100 ohms source resistance.

A print command is available at the end of each display period. The command is a positive transistion from 0.5 ±0.5v to 13 ±5v with source resistance of 1 kilohm in the high condition and less than 100 ohms in the low condition.

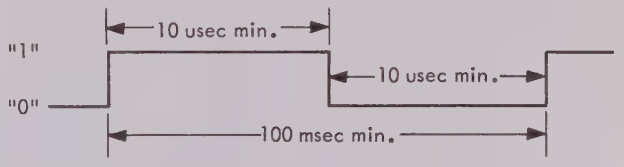
REMOTE OPERATION
Remote control of display time and self-calibration system is provided with each instrument. Digital output options also provide capability for remote control of range. Remote control is actuated by furnishing +3 to +20v to the proper rear connector terminal. A source of ±13.6v is available at the rear connector for this purpose. Remote controls over-ride front panel controls.

The signal levels for remote range, calibrate or sample enable are:

Logic "1" = +3v to +20v

Logic "0" = +1 and -5 volts dc or an open circuit.

The remote sample command is a logic "1" pulse as shown below:



The signal requirements are:

Logic "1" = +3v to +20v with a pulse width of 10 microseconds or greater and a minimum repetition period of 100 milliseconds.

Logic "0" = +1v to -5v with a minimum duration of 10 microseconds.

LINE REGULATION
Less than 1 digit change for ±10% line voltage change.

INPUT POWER
115/230 volts ac ±10%, 50 to 440 Hz, approximately 37 watts.

TURN-ON WARM UP
On initial turn-on the instrument will exhibit an additional error of less than 0.05%. After a 60 minute warm up period, full specifications will be met.

1-7. MECHANICAL AND ENVIRONMENTAL SPECIFICATIONS

OPERATING TEMPERATURE RANGE
0° C to 50° C.

STORAGE TEMPERATURE RANGE
-40° C to 70° C.

RELATIVE HUMIDITY
0 to 90% operating with the following exceptions:

From 50 Hz to 10 kHz, less than 0.03% additional error for relative humidity greater than 70%;

From 10 kHz to 50 kHz, less than 0.05% additional error for relative humidity greater than 70%;

From 10 kHz to 50 kHz, less than 0.07% additional error for relative humidity greater than 80%.

SHOCK
Meets requirements of MIL-T-945A.

VIBRATION
Meets requirements of MIL-T-945A.

MOUNTING
Standard EIA relay rack (tapped for attachment of slides).

SIZE
5-1/4" high x 17" wide x 15" deep. See Figure 1-2 for outline drawing.

WEIGHT
28 lbs.

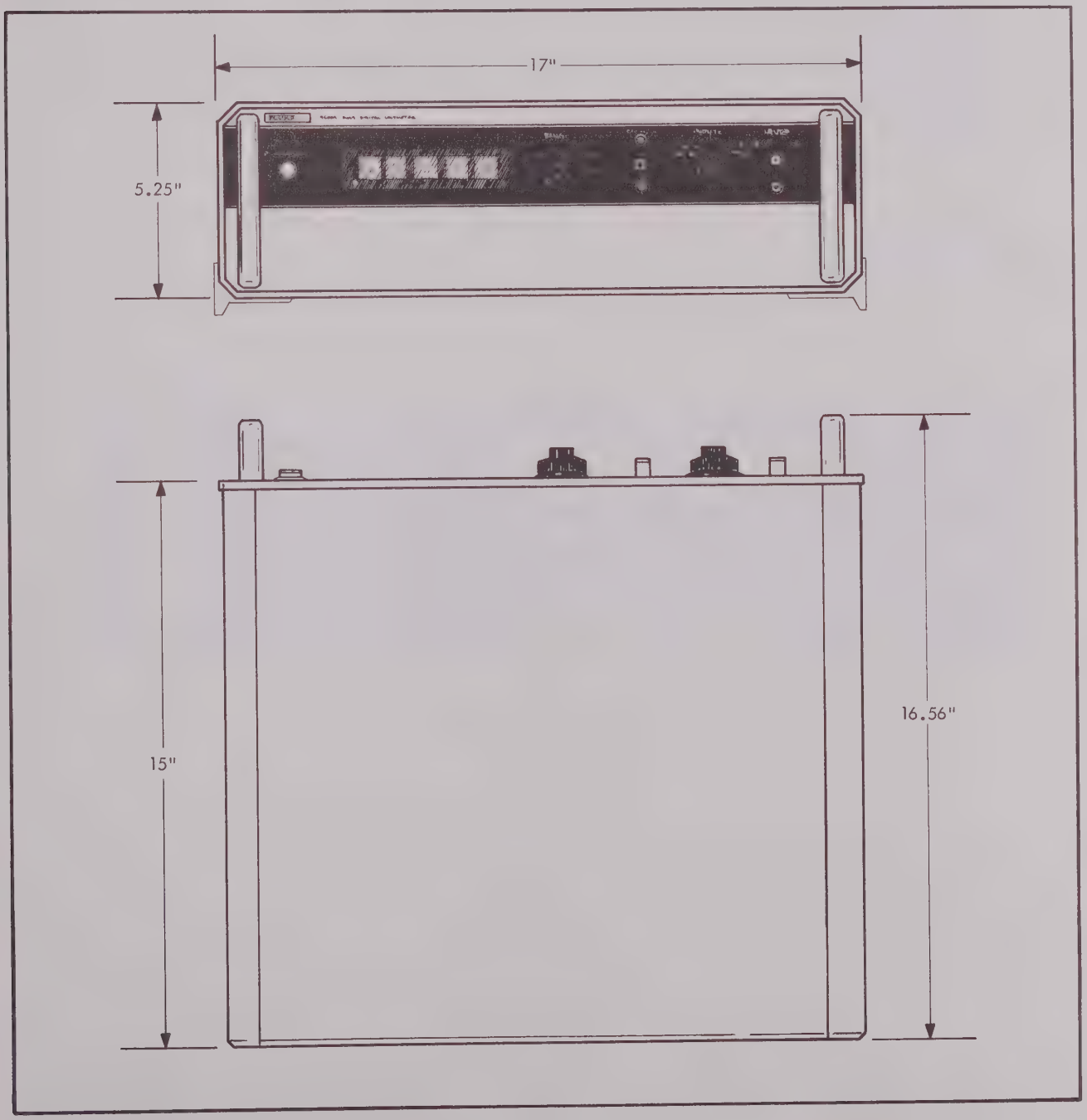


Figure 1-2. MODEL 9500A OUTLINE DRAWING

SECTION II

OPERATING INSTRUCTIONS

2-1. INTRODUCTION

2-2. This section of the manual contains information necessary for you to effectively operate your Model 9500A RMS Digital Voltmeter. It is recommended that you thoroughly read and understand this section of the manual before attempting to operate your instrument.

2-3. Should any difficulties be encountered during the operation of your instrument, please feel free to contact your nearest John Fluke Sales Representative or write directly to the John Fluke Mfg. Co., Inc., P. O. Box 7428, Seattle, Washington with a statement of your problem. A complete list of Sales Representatives is contained at the rear of this manual.

2-4. INSTALLATION

2-5. The Model 9500A RMS Digital Voltmeter is designed for mounting in a standard 19 inch relay rack or for bench top use. Rack mounting brackets are supplied with each instrument and the chassis is designed to accept Jonathan 120QD (quick disconnect) chassis slides. A tilt bail and resilient feet have also been provided to facilitate bench top use. If the instrument is rack mounted, the resilient feet and tilt bail should be removed. To modify your instrument for rack installation, proceed as follows:

a. Peel the decals from both front sides of the instrument and install the rack mounting brackets. Refer to Figure 2-1 for location of the rack components.

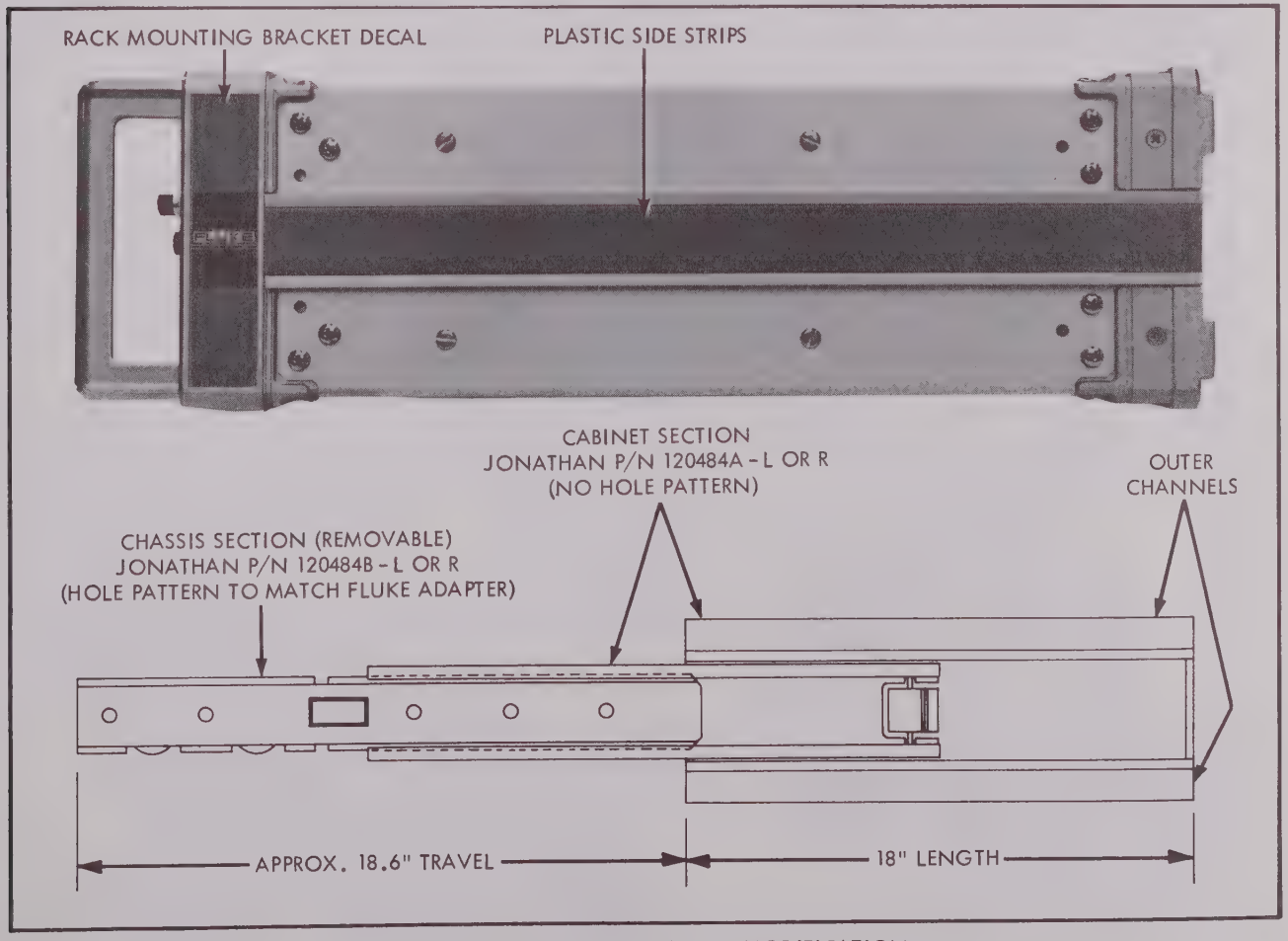


Figure 2-1. RACK INSTALLATION MODIFICATION

b. Remove the plastic side strips from the instrument by sliding them toward the rear of the instrument.

c. Install the Jonathan 120QD chassis slides on the instrument.

d. Remove the resilient feet and tilt bail from the instrument and install the instrument in the relay rack or cabinet.

2-6. OPERATION FROM 115/230 VOLT AC POWER LINES

2-7. The Model 9500A may be operated from either a 115 or 230 volt ac power line. The input power transformer primary is composed of two windings which, when connected in parallel, allows the instrument to be operated from a 115 volt ac power line or, when the windings are connected in series, allows the instrument to be operated from a 230 volt ac power line.

2-8. This instrument is usually shipped wired for operation from a 115 volt ac power line. However, if requested, the instrument is wired at the factory for operation from 230 volt ac power line. A rear panel decal will indicate the necessary 115 or 230 volt ac power required to operate the instrument. To convert your instrument to either 115 or 230 volt ac power input, proceed as follows:

a. Disconnect the Model 9500A line cord from line power.

b. Remove the bottom outer and inner covers from the instrument.

c. Locate the power transformer T1 and solder the jumper wires in the desired 115 or 230 volt power line configuration. Refer to Figure 2-2 for the location and jumper wire connections for T1.

d. Install the corresponding 115 or 230 volt 3/4 or 1/2 ampere AGC fuse in the rear panel fuseholder.

e. Replace the inner and outer bottom covers.

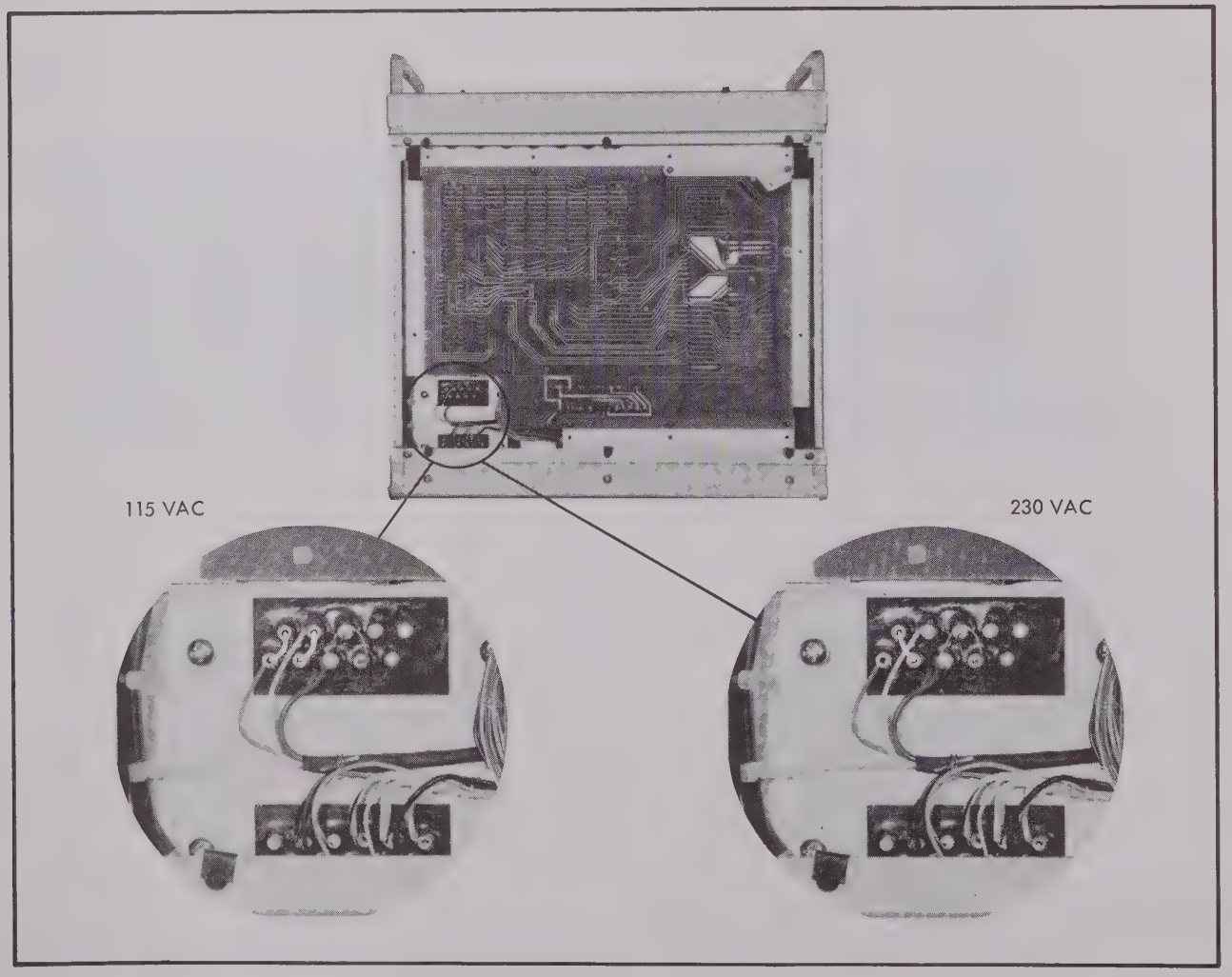


Figure 2-2. 115/230 VAC POWER TRANSFORMER CONNECTIONS

2-9. OPERATING FEATURES

2-10. All of the Model 9500A controls, terminals, and indicators are illustrated and described in Figure 2-3.

2-11. PRELIMINARY OPERATING PROCEDURES

2-12. Connect the Model 9500A power cord to available line power and proceed as follows:

WARNING!

The instruments case is connected to the round pin of the three-prong connector located on the power cord. Whenever the instrument is operated, ensure that this round pin is connected to a high quality earth ground.

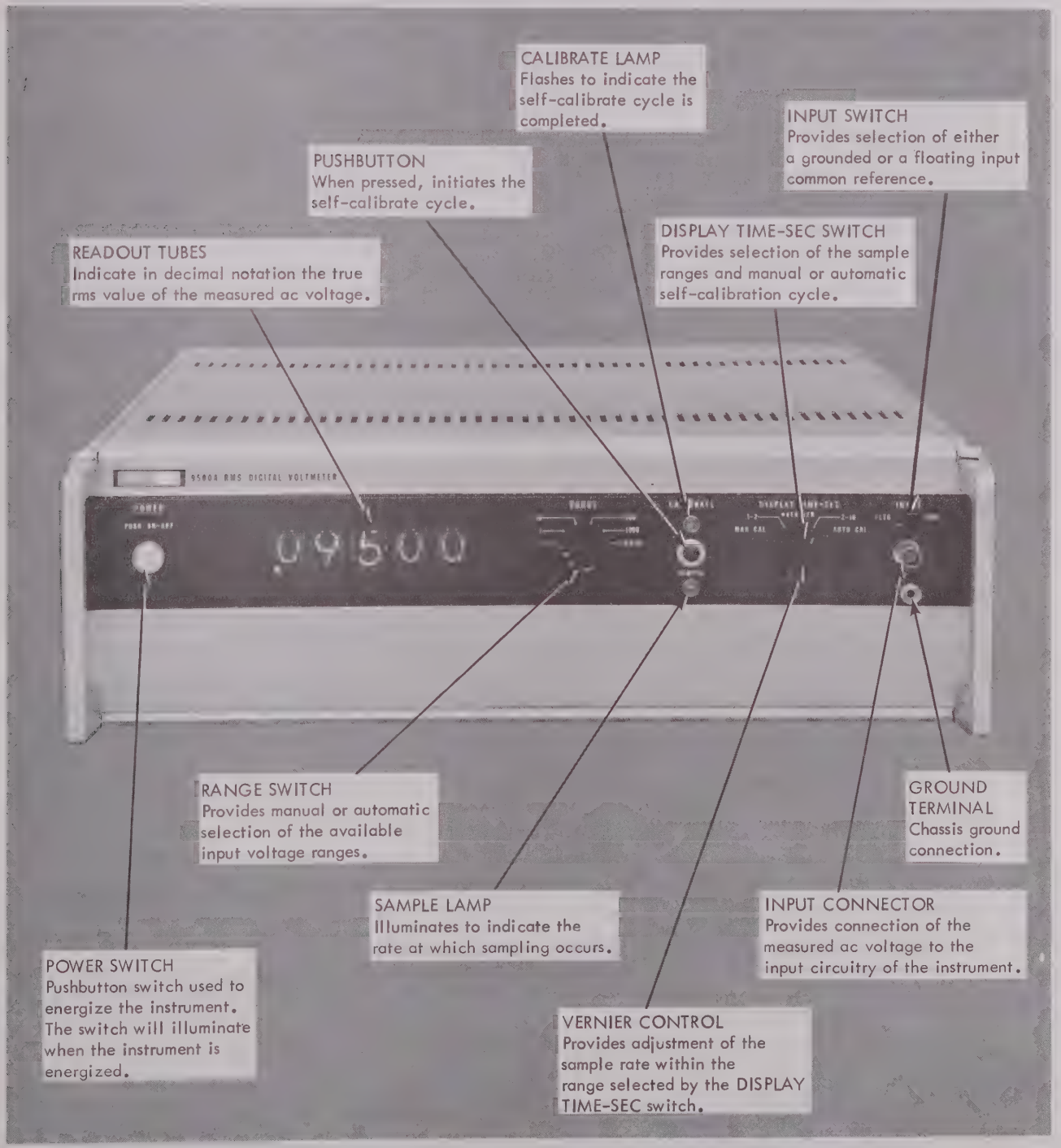

CALIBRATE LAMP
Flashes to indicate the self-calibrate cycle is completed.
INPUT SWITCH
Provides selection of either a grounded or a floating input common reference.
PUSHBUTTON
When pressed, initiates the self-calibrate cycle.
DISPLAY TIME-SEC SWITCH
Provides selection of the sample ranges and manual or automatic self-calibration cycle.
READOUT TUBES
Indicate in decimal notation the true rms value of the measured ac voltage.
RANGE SWITCH
Provides manual or automatic selection of the available input voltage ranges.
GROUND TERMINAL
Chassis ground connection.
SAMPLE LAMP
Illuminates to indicate the rate at which sampling occurs.
INPUT CONNECTOR
Provides connection of the measured ac voltage to the input circuitry of the instrument.
POWER SWITCH
Pushbutton switch used to energize the instrument. The switch will illuminate when the instrument is energized.
VERNIER CONTROL
Provides adjustment of the sample rate within the range selected by the DISPLAY TIME-SEC switch.

Figure 2-3. CONTROLS, TERMINALS, AND INDICATORS (Sheet 1 of 2)

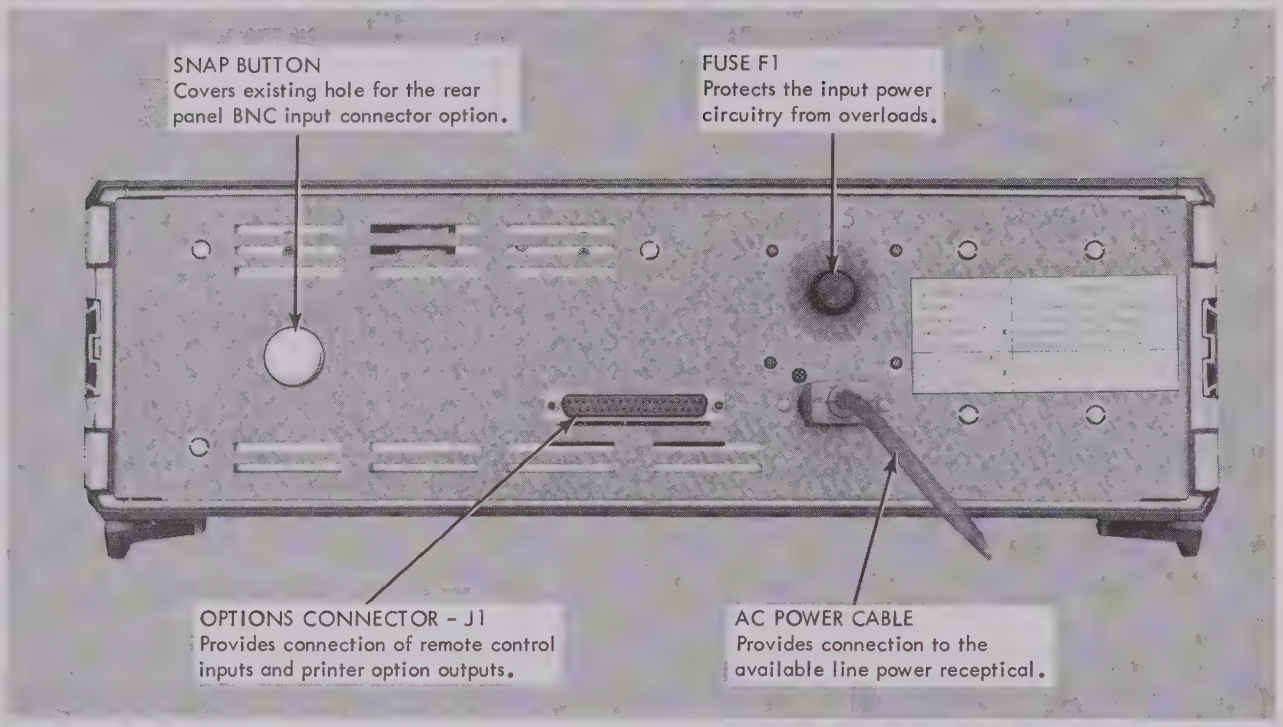

SNAP BUTTON
Covers existing hole for the rear panel BNC input connector option.
FUSE F1
Protects the input power circuitry from overloads.
OPTIONS CONNECTOR - J1
Provides connection of remote control inputs and printer option outputs.
AC POWER CABLE
Provides connection to the available line power receptical.

Figure 2-3. CONTROLS, TERMINALS, AND INDICATORS (Sheet 2 of 2)

a. Place the Model 9500A controls as follows:

INPUT	FLTG
DISPLAY TIME	MAN CAL .1-2 or AUTO CAL 2-10
VERNIER	Fully CCW
RANGE	1000

b. Press the POWER switch, observing that the switch illuminates.

Note!

Upon pressing of the POWER switch, a turn-on calibration cycle of 20 to 25 seconds is initiated. During this turn-on calibration time the readout is blanked and the CALIBRATE lamp should intermittantly illuminate.

c. Observing the illumination rate of the SAMPLE lamp, adjust the VERNIER control for the desired sample rate.

Note!

When display times of .1 to 2 seconds are used, the instrument can be calibrated by pressing the CALIBRATE pushbutton or remotely by application of a +3 to +20 volt dc signal to pin 34 of the rear panel connector. For display times of 2-10 seconds the instrument is automatically self-calibrated. Refer to the Section VI Printer Option subsection for remote operation features.

d. The desired measurements can now be performed at a slightly reduced accuracy during the first hour of operation. After one hour of operation full measurement specifications will be met.

2-13. OPERATIONAL TEST

2-14. The following information is provided for the installation and operating personnel to verify instrument operation. These tests will check relative instrument operation and are not intended as instrument performance checks. Should you wish to check the accuracy of the instrument against the specifications contained in Section I, refer to the Performance Checks described in Section IV of this manual.

2-15. To determine relative instrument operation, perform the operations described in the Preliminary Operating Procedures (paragraphs 2-11 and 2-12) and proceed as follows:

a. Press the calibrate button, observing that the CALIBRATE lamp illuminates intermittently as long as the switch is pressed.

Note!

If the instrument has been previously operated in the MAN CAL mode without periodic calibration, it may take up to 20 seconds before the CALIBRATE lamp illuminates.

b. Place the RANGE switch to .1 and short the INPUT. This is accomplished on the BNC INPUT versions by connecting a shorting jumper between the inner and outer portions of the BNC INPUT connector. On the probe version instruments, connect the probe ground clip to the probe tip.

c. The readout should indicate less than 25 digits or 250 microvolts.

d. Place the RANGE switch to 1, observing that the decimal point moves one to the right and that the residual readout is less than 15 digits.

e. Place the RANGE switch to the 10, 100, and 1000 positions, observing that the decimal point moves one place to the right as the range is increased. A residual reading of 8-12 on these ranges should also be obtained.

f. Place the RANGE switch to AUTO, observing that the decimal point returns to the .1 range (left) position.

g. Place the DISPLAY TIME-SEC switch to MAN CAL .1 to 2, observing that the SAMPLE lamp illuminates at a rapid rate of approximately ten times a second.

h. Rotate the VERNIER control fully clockwise, observing that the SAMPLE lamp illumination rate decrease to approximately once every two seconds.

i. Place the DISPLAY TIME-SEC switch to AUTO CAL 2-10, observing that the SAMPLE lamp illuminates once every ten seconds.

j. Observe that the CALIBRATE lamp illuminates on every other illumination of the SAMPLE lamp. Occasionally the CALIBRATE lamp will not illuminate due to the relatively short calibrate time of one half second.

k. Rotate the VERNIER control fully counter-clockwise, observing that the SAMPLE lamp illuminates once every two seconds.

l. Place the DISPLAY TIME-SEC switch to MAN CAL .1-2.

m. Remove the short from across the INPUT and apply an input signal of 120 volts ac. This can be obtained from the line power source.

n. The readout should rapidly increase to a reading of approximately 120.0 in less than five seconds.

o. Remove the ac input voltage, observing that the readout rapidly decreases to a residual reading of 0.0013 or 0.0014.

2-16. If the results of the Operational Test agree with the information given, it can be assumed that the instrument is operating properly and measurements of ac voltages can now be performed.

2-17. OPERATING NOTES

2-18. USE OF INPUT SWITCH

2-19. A chassis within a chassis construction is used to provide measurement of signals having a reference other than ground. The outer chassis of the instrument is connected to power system ground through the line cord. Whenever the INPUT switch is placed to the GRD position the outer chassis is connected to the inner chassis, thus providing a ground reference for the low side of the input to the instrument. To perform measurement of ac signals having a reference other than ground, the INPUT switch is placed to the FLTG position which disconnects the outer chassis from the inner chassis. The power system ground is thus removed from the low side of the input to the instrument, and the isolated ac measurement can then be made. The resulting floating impedance of the instrument is greater than 10^8 ohms shunted by less than 2000 pf and the low side of the input can be driven up to 600 volts dc or to 600 volts peak ac.

2-20. An added benefit derived from this chassis within a chassis construction is the shielding effect of the inner chassis which provides an increase in the common mode rejection. Refer to Section I for the common mode specifications.

2-21. GROUND LOOP CURRENTS

2-22. A potential difference often exists between different points of power system grounds. Consequently, current may flow from one power system ground through the voltmeter and the voltage source being measured to another power system ground. These ground loop currents should be avoided as they generate voltages that degrade measurement accuracy. To prevent these ground loop currents when the source being measured is grounded, place the INPUT switch to the FLTG position.

2-23. OPERATION BELOW ONE TENTH SCALE

2-24. The basic accuracy specifications of the Model 9500A apply from one tenth of full range to full overrange. When the instrument is operated in the automatic ranging mode, it automatically shifts to the next lower range when the input voltage decreases below one tenth range until it reaches the 100 millivolt range. Measurements of voltages below one tenth of range may be made with reduced accuracy with the instrument operating in the manual ranging mode or in automatic ranging mode when the input voltage is less than 10 millivolts. Figure 2-4 shows the typical accuracy of readings below one tenth of full range for all ranges except 100 millivolts. Figure 2-5 shows the typical accuracy of readings below 10 millivolts on the 100 millivolt range.

2-25. OPERATING PROCEDURES

2-26. AUTOMATIC OPERATION

2-27. Fully automatic rms voltage measurements from 0.4 millivolts to 1200 volts ac are available with the Model 9500A RMS Digital Voltmeter. To operate

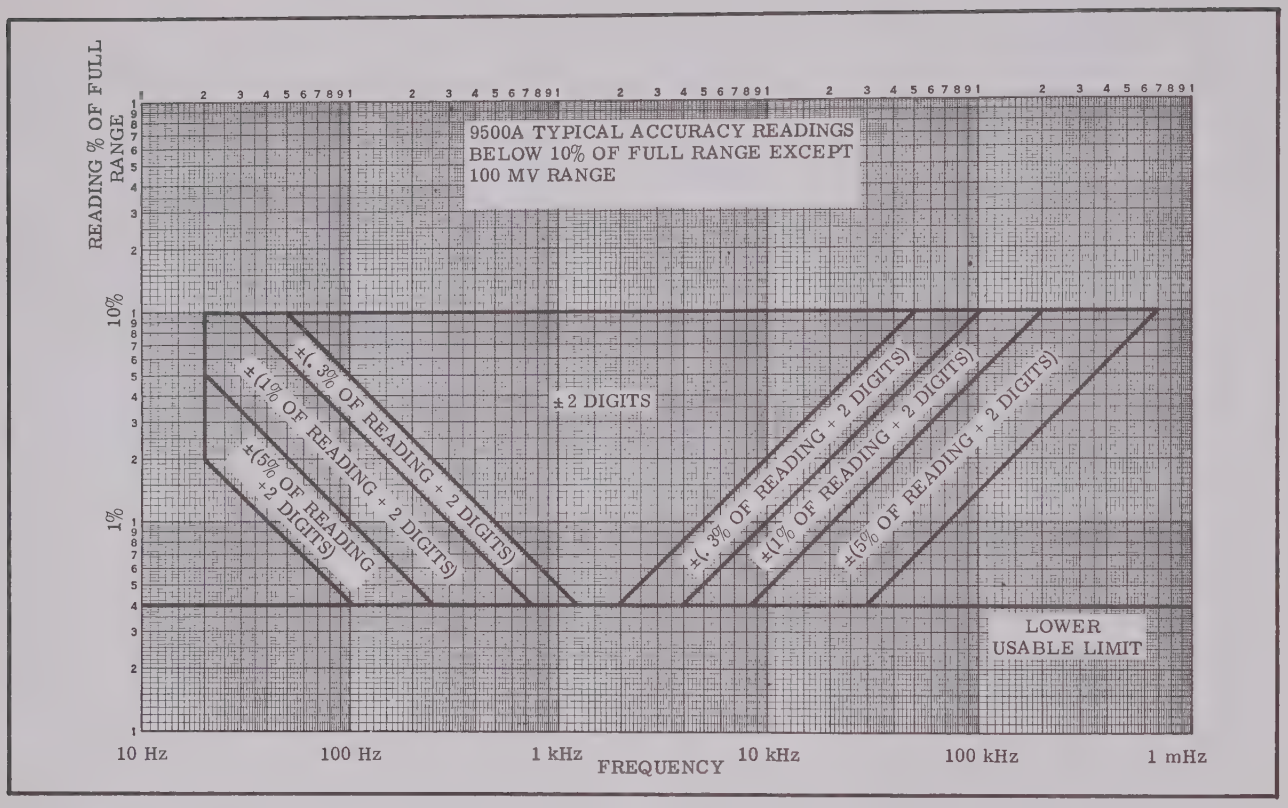


Figure 2-4. TYPICAL ACCURACY OF READINGS BELOW ONE TENTH OF FULL RANGE EXCEPT .1 VOLT RANGE

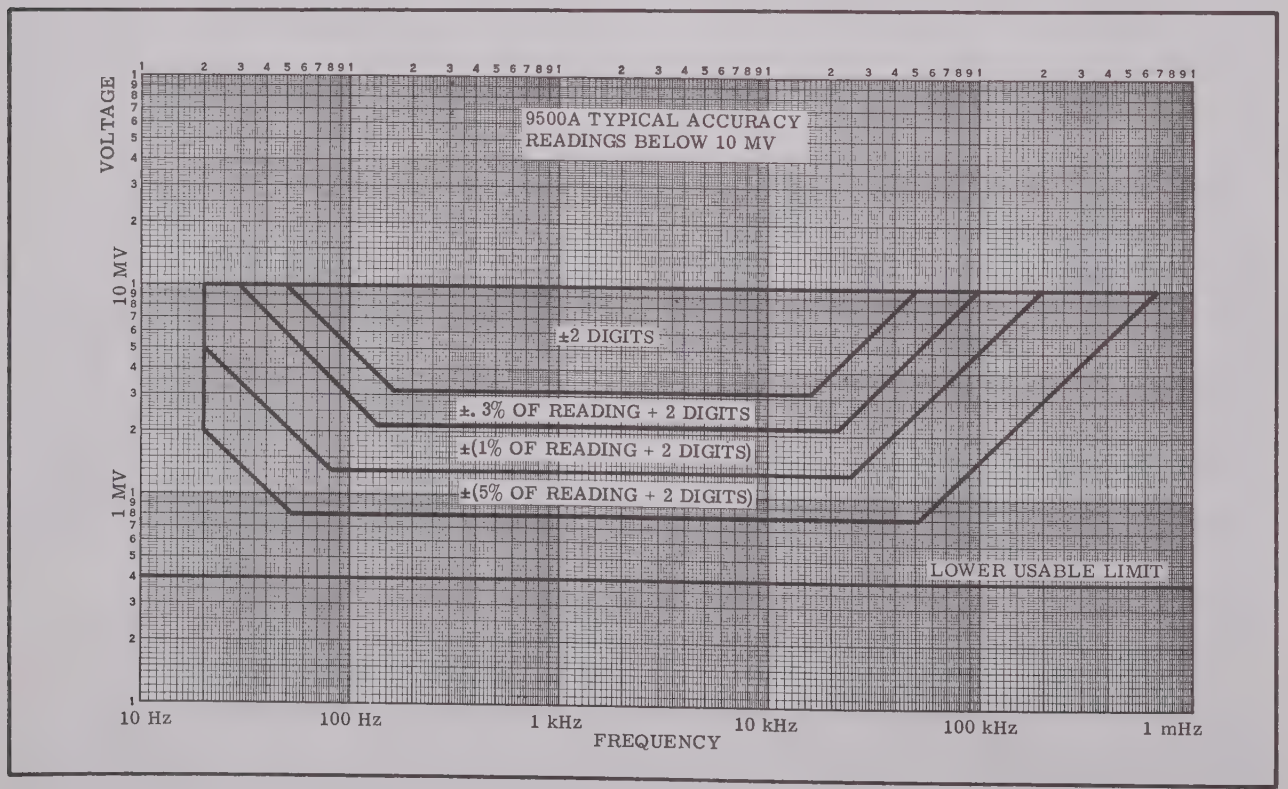


Figure 2-5. TYPICAL ACCURACY OF READINGS BELOW 10 MV

the instrument as an automatic rms voltmeter, perform the operations described in the Preliminary Operating Procedures (paragraphs 2-11 and 2-12) and proceed as follows:

a. Determine that the ac source to be measured is either floating or grounded and place the INPUT switch to the corresponding FLTG or GRD position.

CAUTION!

During floating source measurements, damage may occur to the source, the Model 9500A, or both if the low input of the instrument is driven in excess of 600 volts dc or 600 volts ac peak. Damage may also occur if the INPUT switch is inadvertantly placed to the GRD position during floating measurements.

b. Place the RANGE switch to AUTO and connect the ac source to be measured to the Model 9500A INPUT connector or probe.

c. The true rms value of the measured ac source is now directly indicated by the front panel readout tubes.

Note!

Measurements below 10 millivolts are made at a reduced accuracy. Refer to Figure 2-5 for typical accuracies.

2-28. MANUAL OPERATION

2-29. The Model 9500A RMS Digital Voltmeter can be manually operated on input ac voltage ranges of .1, 1, 10, 100, or 1000. However, measurements at less than one tenth of these selected ranges are made with a reduced accuracy. Refer to Figures 2-4 and 2-5 for the reduced accuracy specifications. To manually operate the Model 9500A, perform the operations described in the Preliminary Operating Procedures (paragraphs 2-11 and 2-12) and proceed as follows:

a. Determine that the ac source to be measured is either floating or grounded and place the INPUT switch to the corresponding FLTG or GRD position.

CAUTION!

During floating source measurements, damage may occur to the source, the Model 9500A, or both if the low input of the instrument is driven in excess of 600 volts dc or 600 volts ac peak. Damage may also occur if the INPUT switch is inadvertantly placed to the GRD position during floating measurements.

b. Connect the ac source to the Model 9500A INPUT connector or probe.

c. Place the RANGE switch to the position that causes a readout of better than one tenth of the selected range.

d. The true rms value of the measured ac source is now directly indicated by the front panel readout tubes.

2-30. REMOTE OPERATION

2-31. All versions of the Model 9500A are provided with remote control features for the self-calibrate cycle and sample rate. These features, when activated, will override the front panel controls regardless of their positions. Remote control of all measurement functions is available upon the installation of either printer option. Information pertaining to all of these remote control features is contained in the Section VI Printer Option Information subsection.

2-32. OPTIONS

2-33. Optional features available for the Model 9500A include an (-01) front panel probe input, an (-02) rear panel BNC connector input, an (-03) 1-2-4-8 printer BCD output and an (-04) 1-2-2-4 printer BCD output. Refer to Section VI for information on each of these options.

SECTION III

THEORY OF OPERATION

3-1. INTRODUCTION

3-2. The theory of operation for the Model 9500A RMS Digital Voltmeter is contained in this section of the manual. A complete description of the assembly numbers, component designations, and schematic drawing numbers is first discussed to orient you with the drawings contained in the manual. A discussion concerning basic rms measurement principles and the logic circuits contained in the instrument is then used to introduce the type of circuitry contained in the instrument. A functional block diagram analysis followed by a detailed circuit description of each particular block section is then used to completely describe all of the circuitry contained in the instrument.

3-3. Since this information can be an asset when used to troubleshoot the instrument, it is recommended that this section of the manual be thoroughly read and understood before attempting any maintenance on the instrument.

3-4. DESCRIPTIVE NOMENCLATURE

3-5. The following numbering systems are employed in the Model 9500A to identify specific assemblies and to completely identify any electrical component on an assembly.

3-6. ASSEMBLY REFERENCE DESIGNATIONS

3-7. Each printed circuit assembly in the Model 9500A has been assigned a letter-number combination that identifies that assembly. For example, the letter-number A1 has been assigned to the Power Supply "A" P/C Assembly. An electrical component on an assembly may then be completely described using the following format.

A1	R1
Power Supply "A" P/C Assembly	Resistor, wirewound, 0.3 Ω ±5%, 2w

3-8. MANUFACTURING PART NUMBER

3-9. There are two different types of manufacturing part numbers. Each type identifies a particular stage of an assembly during manufacturing.

a. A complete printed circuit assembly is identified by a 9500A-4000 series number. For example the Power Supply "A" P/C Assembly is identified by the number 9500A-4001.

b. A module printed circuit assembly having no electrical components is identified by a 9500A-3000 series number. For example, the Power Supply "A" printed circuit board is identified by the number 9500A-3001. This 3000 number can be found etched on one side of the printed circuit board.

3-10. SCHEMATIC NUMBERS

3-11. The schematics and printed circuit assemblies in the Model 9500A are numerically related. A complete printed circuit assembly is identified by a 9500A-4000 series number while the schematic diagram for the printed circuit assembly is identified by a 9500A-1000 series number. For example, the 9500A-4001 printed circuit assembly is described by a 9500A-1001 schematic diagram. However, as the manufacture of the instrument progressed, the micrologic circuitry was replaced with dual inline logic and new assemblies were created. These assemblies are identified by the 9500A-4000 series number and, because the schematic diagram title has not been changed, the early version schematic diagram number has been retained. In order to determine which schematic applies to the assembly contained in your instrument, refer to the instrument serial number information located below the schematic diagram title.

3-12. RMS MEASUREMENT PRINCIPLES

3-13. INTRODUCTION

3-14. The ac standards maintained by the National Bureau of Standards are comprised of a reference group of vacuum thermocouples and thermal voltage converters. These standards respond to the heating effect of an applied ac or dc signal which is then compared to the heating effect of a standard dc voltage. However, because of the theoretical uncertainty of intercomparison as a means of establishing an absolute standard, the resulting NBS test reports contain a basic uncertainty of ±100 ppm.

3-15. Because of the basic uncertainty involved in the NBS test reports, ac measurements made with an absolute accuracy of 0.1% or better can be considered to be highly accurate. The results of these ac measurements are usually expressed mathematically as the root-mean-square (rms) value. This rms value is equal to the amount of alternating current that will produce the same heating effect as an equal amount of dc current.

3-16. VACUUM THERMOCOUPLES

3-17. Vacuum thermocouples provide an excellent means for accurately sensing the rms value of an ac voltage since they respond only to the heating effect of the alternating current and are essentially independent of the waveform shape. A vacuum thermocouple is com-

prised of an evacuated glass envelope containing a resistive heater element and an electrically isolated thermocouple junction. The thermocouple junction senses the temperature of the heater element and produces an output emf which is proportional to the temperature of the heater element. Since the temperature of the heater element is proportional to its dissipated power, which is in turn proportional to the square of the heater element ac current, the thermocouple junction output emf is nearly proportional to the square of the applied heater element input signal. Deviations from exact square law output characteristics are caused by the heater element temperature coefficient, radiation losses from the heater element, and other affects.

3-18. The ac-dc thermal transfer technique previously discussed in paragraphs 3-14 and 3-15 does not readily lend itself to direct reading instrumentation. However, the same measurement process may be performed continuously by using the differential connection of two vacuum thermocouples as illustrated in Figure 3-1. Using accurately matched thermocouples in this arrangement, the combined output of two thermocouples will be zero (null) when the ac input signal is equal to the dc reference. Mis-match of the transfer characteristics of the thermocouples will cause errors as the ac and dc inputs are varied. In addition, relatively poor temperature coefficient matching and poor differential long term stability will also require that recalibration of the thermocouples be accomplished periodically to maintain an accurate null comparison over a long period of time.

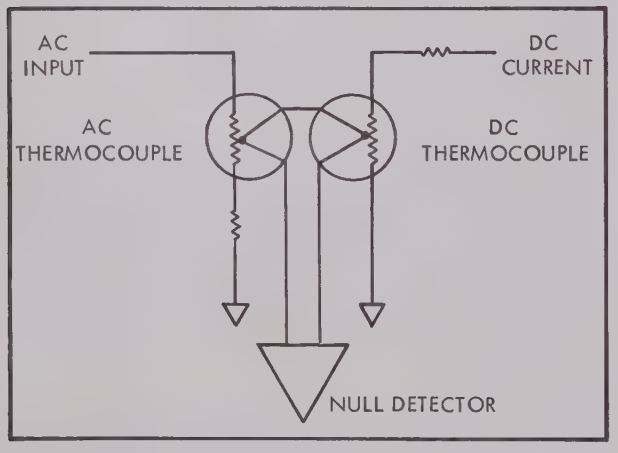


Figure 3-1. DIFFERENTIAL CONNECTION OF THERMOCOUPLES

3-19. The effects of these problems have been overcome in the Model 9500A by first preceding the ac input to the thermocouple with a variable gain amplifier and secondly, by automatic or semi-automatic thermocouple calibration circuitry. Figure 3-2 illustrates a greatly simplified block diagram of the instrument's circuitry. The variable gain amplifier is used so that the measurement is always performed at the same output level to the thermocouples thereby eliminating transfer characteristics and mis-match problems. Since the gain of the ac amplifier is accurately known, the rms value of the input can then be determined by the amplifier gain setting required to obtain the fixed current level at the ac thermocouple. The thermocouple calibration circuitry provides a means of eliminating the temperature and long-term drift characteristics of the thermocouples.

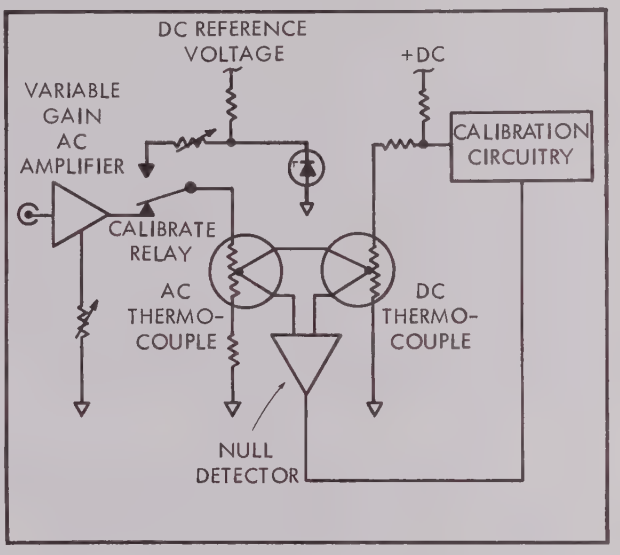


Figure 3-2. SIMPLIFIED MODEL 9500A BLOCK DIAGRAM

3-20. INTEGRATED CIRCUITS

3-21. INTRODUCTION

3-22. Integrated circuits are used extensively throughout the circuitry of the Model 9500A. These integrated circuits perform the necessary counting and control functions in a logical sequence to achieve the desired measurement results. The symbols used to denote the logic functions of these integrated circuits are illustrated in Figure 3-3.

3-23. Two types of logic language (negative or positive) are used in Boolean truth table notations. In negative logic notations, low is "1" or TRUE, and high is "0" or FALSE. In the positive logic notations, high is "1" or TRUE, and low is "0" or FALSE. Negative logic notations, except where noted, are used on all the schematic diagrams of the Model 9500A.

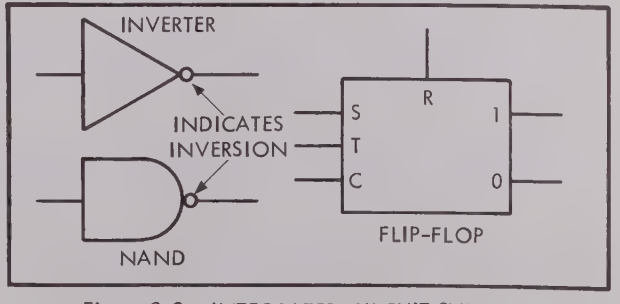


Figure 3-3. INTEGRATED CIRCUIT SYMBOLS

3-24. LOGIC CIRCUITS

3-25. The inverting buffer illustrated in Figure 3-3 is a low-impedance inverting amplifier used to drive heavily loaded circuits or for minimizing rise-time deterioration of pulses due to capacitive loading. Output signals from this circuit will always be opposite or inverted with respect to the input signal. The 2 input NAND Gate provides a low (1) output whenever the input at either or both inputs is (0) or high. A low (1) input to both input terminals results in a high (0) NAND output. The exact logic language for the NAND Gate is illustrated in Figure 3-4.

INPUT		OUTPUT
1	2	
0	0	1
0	1	1
1	0	1
1	1	0

Figure 3-4. 2 INPUT NAND GATE TRUTH TABLE

3-26. Operation of the flip-flop is slightly more complicated than that of the NAND Gate. Upon the application of a low (1) input signal at the "T" trigger terminal, the flip-flop output voltages are set to a state determined by the output voltages before triggering and/or the input voltages at the set "S" and clear "C" terminals. Figure 3-5 illustrates the exact logic conditions at output "1" following the application of an input trigger. The notation X^n in the first line indicates that the output voltages remain unchanged before application of the trigger signal. Notation $\overline{X^n}$ in the last line indicates opposite output conditions before triggering. For example, if output "1" is low (1) before triggering, it will be high (0) after triggering. The output "0" is always the opposite of output "1" and therefore is not illustrated in Figure 3-5. Another terminal not described in Figure 3-5 is the reset "R" terminal. When this input is triggered by a high (0) input, output "1" will be set to a low (1) state regardless of the other input conditions.

INPUT AT TIME ZERO		OUTPUT AFTER ONE TRIGGER INPUT
S	C	OUTPUT 1
0	0	X^n
0	1	0
1	0	1
1	1	$\overline{X^n}$

Figure 3-5. FLIP-FLOP TRUTH TABLE

3-27. An UP counting binary counter is provided by connecting two flip-flops in the manner illustrated in Figure 3-6a. The basic flip-flop truth table of Figure 3-5 indicates that upon the receipt of a trigger pulse the flip-flop will reverse the state of its "1" and "0" outputs if there are low inputs to both the "S and C" terminals. By observing the truth tables of Figures 3-5 and 3-6a, note that it takes two counts or input triggers to get a complete change of state at the flip-flop outputs. From the truth table of Figure 3-6a we find that on an UP counting cycle a one count will net a (1) state from the "0" output terminal of flip-flop #1. A two count will cause a (0) state from flip-flop #1 and a (1) state from flip-flop #2 "0" output terminals. A three count will result in a (1) state from both flip-flop "0" output terminals. These outputs from the UP counter can then be added in binary form to provide a 1, 2 or 3 readout. By connecting the #1 and #2 flip-flops in the manner illustrated in Figure 3-6b, a net reciprocal counting sequence (DOWN counting) is provided from the same trigger input. The accompaning truth table illustrates the logic counting sequence of this DOWN counter.

3-28. A reversible binary counter is formed by combining the "1 and 0" outputs of the flip-flops in separate NAND gates with high UP or DOWN gating signals. Figure 3-6c illustrates the appropriate connections. In this arrangement either output of the flip-flop can be used to trigger the following flip-flop, thus providing an UP or DOWN counting sequence. It should be noted at this point that either UP or DOWN gate signal can be present but never both.

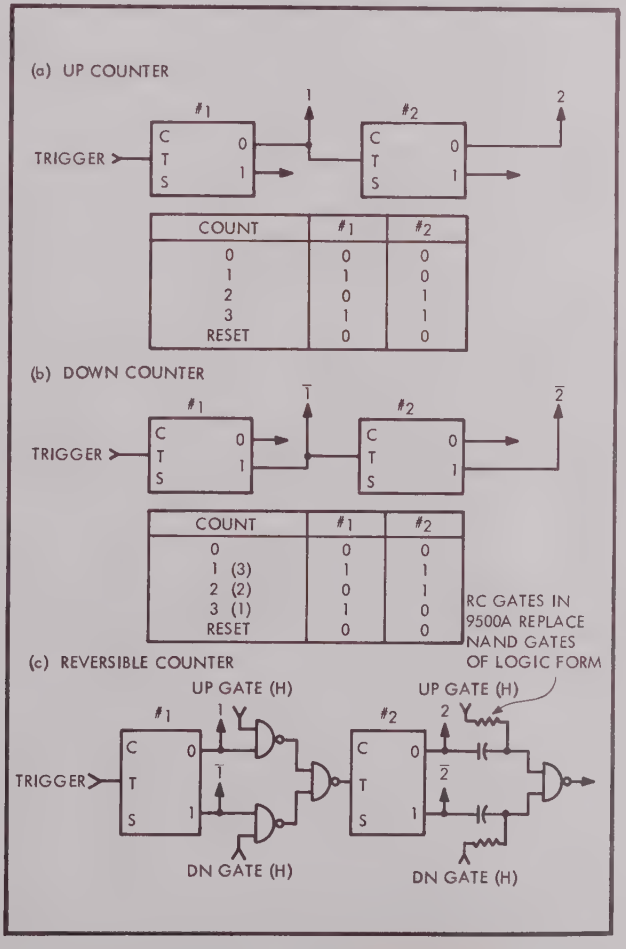
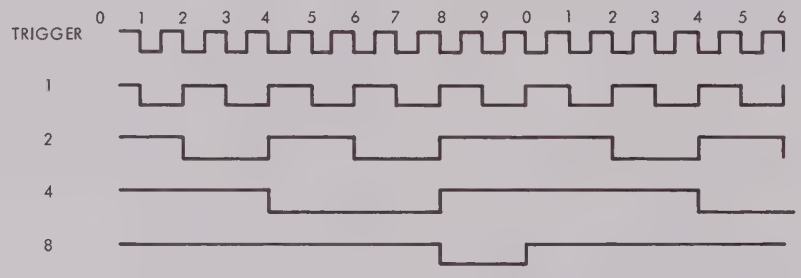


Figure 3-6. BINARY COUNTERS

3-29. BINARY CODED DECIMAL COUNTERS

3-30. The Binary Coded Decimal Counters, commonly referred to as BCD Counters, used in the Model 9500A are composed of four binary flip-flops connected in the manner illustrated in Figure 3-7. The waveforms illustrated in Figure 3-7a show the relationship between the trigger input signal and the resulting coded outputs and how these outputs can be combined in a binary fashion to produce a decimal readout. Upon reaching a count of nine on an up counting sequence, the Carry Flip-Flop trigger input is driven to a low by the output of the UP Transfer gate. The next 9 + 1 count output of the counter causes the output of the UP Transfer gate to change state, which triggers the Carry Flip-Flop. This action presets the counter to a zero count and also supplies a Carry Pulse output to any following counters. Upon reaching a count of zero on a down counting sequence, the Carry Flip-Flop trigger input is again driven to a low by the output of the DN Transfer gate. The next zero minus one count output of the counter causes the output of the DN Transfer gate to change state which triggers the Carry Flip-Flop. However, the low 0 output of the Carry Flip-Flop is not inverted

(a) BCD COUNTER WAVEFORMS



(b) OUTPUTS

DECIMAL INPUT	BINARY OUTPUT
0	0
1	1
2	2
3	1 + 3
4	4
5	4 + 1
6	2 + 4
7	1 + 2 + 4
8	8
9	8 + 1

(c) 0 - 9 BCD COUNTER

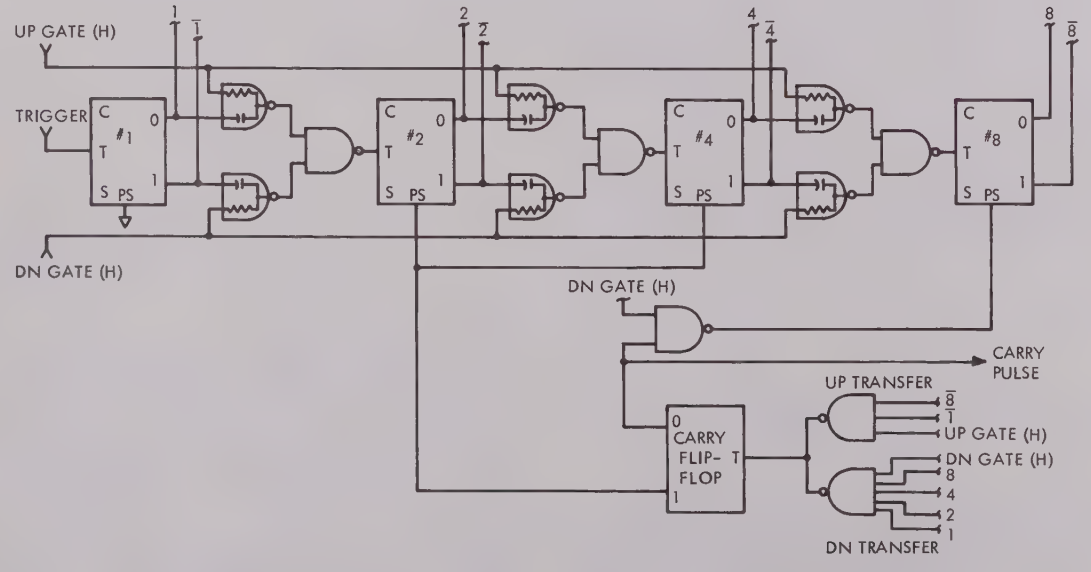


Figure 3-7. BCD COUNTER

by the associated NAND gate because of the presence of the high DN Gate signal, resulting in the counter being preset to a nine count.

3-31. BLOCK DIAGRAM ANALYSIS

3-32. INTRODUCTION

3-33. The following paragraphs first describe the instrument in a greatly simplified form using the block diagrams illustrated in Figures 3-8 and 3-9. A more detailed discussion of the Functional Block Diagram, Drawing No. 9500A-1000-1, is then used to more completely describe the instrument.

3-34. MEASUREMENT LOOP-SIMPLIFIED

3-35. A simplified diagram of the Model 9500A measurement loop is illustrated in Figure 3-8. Input ac voltages to the instrument are amplified by the operational amplifier whose output current passes through the heater element of TC1. The transconductance of the operational amplifier is precisely controlled by the resistance in its feedback network which is determined by count of the decade counters. Thermocouple TC1 produces a dc output proportional to its ac heater current, which is applied to the null detector. The null detector compares the dc output of TC1 to the dc output of TC2 and any resulting difference is used to drive the following UP-DOWN switch and VCO. If the dc output of TC1 is above or below the dc output of TC2, a corresponding UP or DOWN gate is developed by the UP-DOWN switch. This UP-DOWN gate is applied to the decade counters to control the direction of their counting sequence. The VCO generates a squarewave output having frequency proportional to the magnitude of the null detector output. This squarewave signal drives the decade counters and the resulting count is applied to the readout and feedback networks. The feedback network circuitry then selects a feedback resistance value inversely proportional to the count of the decade counters. Gain of the operational amplifier is increased or decreased by this action until the dc output of TC1 is equal to the dc output of TC2. At null, the count in the decade counters is equal to the rms value of the input ac voltage. This count is decoded by the readout circuitry and used to drive the readout tubes. A stable readout is obtained by transfering the decade counter outputs to the readout tubes only during the occurance of a sample pulse from the sample circuit.

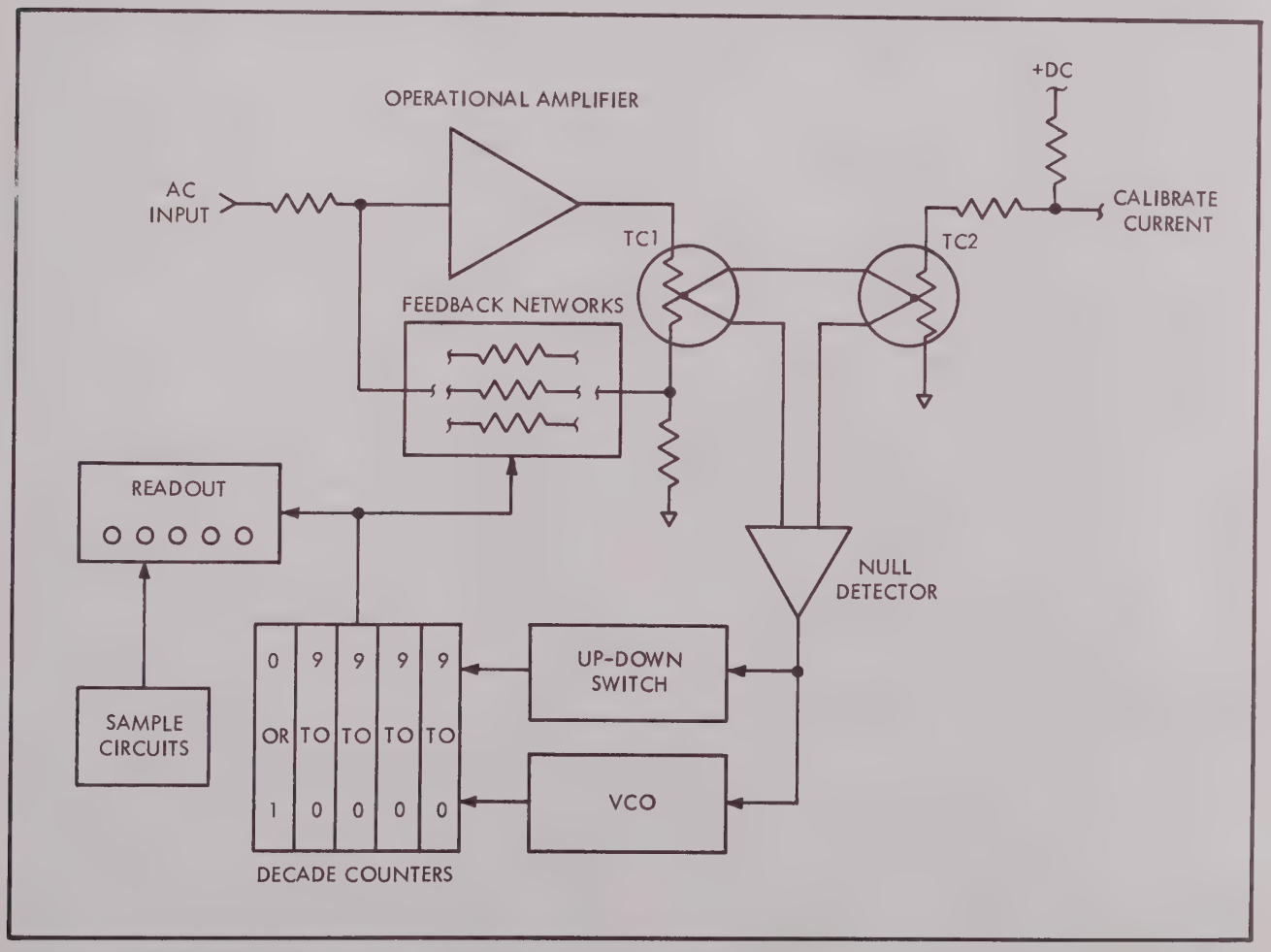


Figure 3-8. MEASUREMENT LOOP - SIMPLIFIED

3-36. SELF CALIBRATION-SIMPLIFIED

3-37. A characteristic of a vacuum thermocouple is that its response tends to drift with temperature and time. Even through a pair of thermocouples may be carefully selected and matched, they drift independently and if no corrections were made, accuracy would be degraded.

3-38. The thermocouples used in the Model 9500A have been provided with the self-calibration circuitry illustrated in Figure 3-9. Self-calibration of the thermocouples can be initiated manually at any time, automatically after every second readout sample, or remotely. The self-calibrate cycle is also initiated for 20 to 25 seconds upon initial turn-on of the instrument.

3-39. Whenever the self-calibrate mode is initiated, the calibrate relay disconnects the ac thermocouple TC1 from the output of the operational amplifier and applies a dc reference current through the heater element of TC1. The null detector compares the output of TC1 to TC2 and any resulting difference is used to drive the following UP-DOWN switch and VCO. Outputs from the UP-DOWN switch and VCO, which operate in the same manner as in the previously discussed measurement loop, drive the calibrate logic circuitry. The calibrate logic circuitry counts the VCO output in the direction determined by the UP-DOWN switch and increases or decreases the current through the heater of TC2 until its output matches that of TC1. Illumination of the CALIBRATE lamp is obtained whenever the output of TC2 matches the output of TC1.

3-40. FUNCTIONAL BLOCK DIAGRAM ANALYSIS

3-41. The circuitry of the Model 9500A can be divided into two separate functions, the measurement and readout circuitry and the self-calibration circuitry. A functional block diagram (Drawing No. 9500A-1000-1) containing all of these circuits and their interconnections is located at the rear of this manual. This functional block diagram is to be used in conjunction with the following block diagram analysis of the instrument.

3-42. MEASUREMENT AND READOUT CIRCUITRY. The measured ac voltage at the probe or BNC input connector is applied through the 1.004 Megohm input attenuator circuit to terminal 26 of the A14 Analog Amplifier Circuits. This ac input voltage is then amplified by the

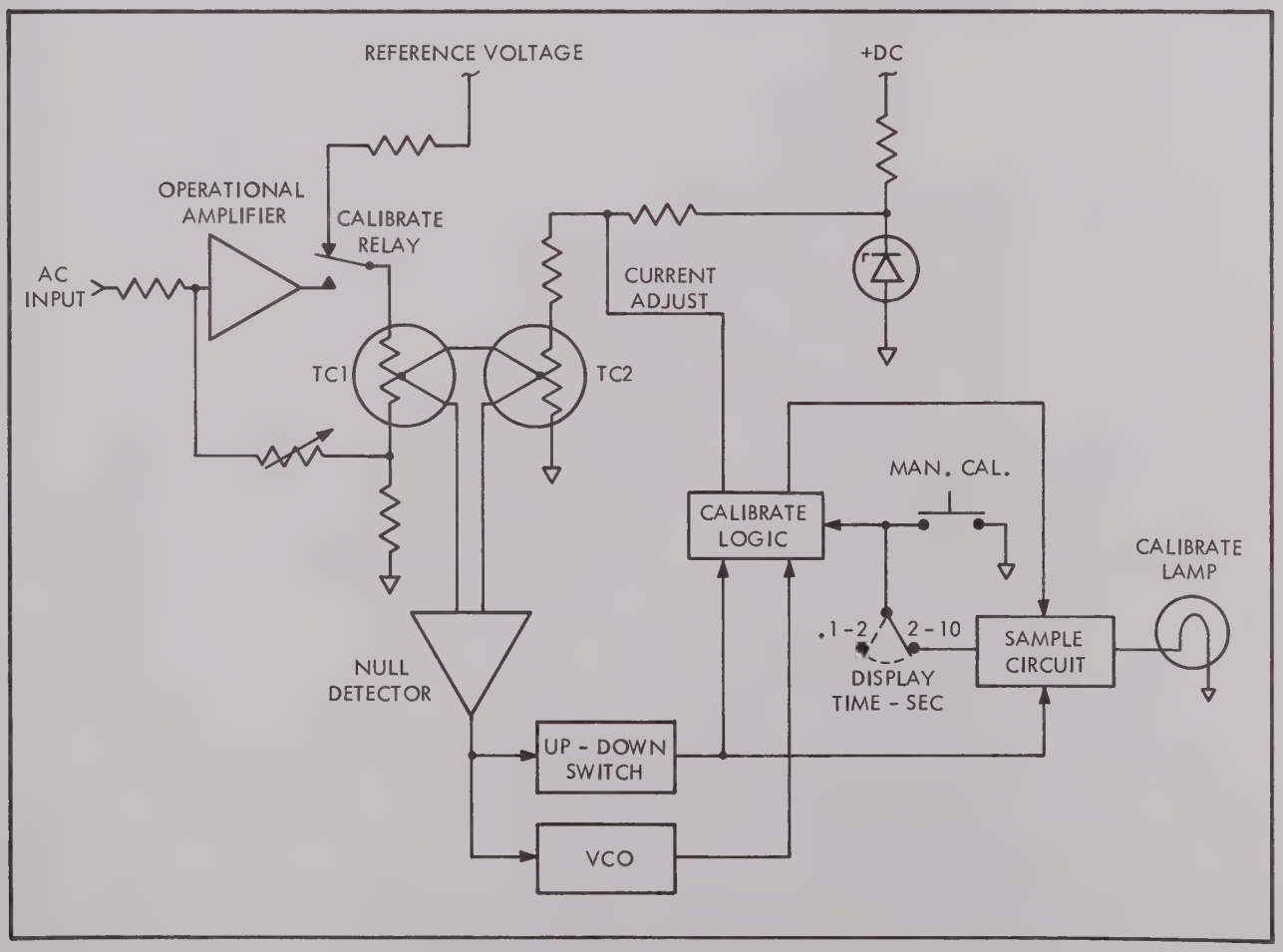


Figure 3-9. SELF CALIBRATION - SIMPLIFIED

range amplifier and applied to the following digit amplifier. Both the range and digit amplifiers are of the operational type; each having a gain proportional to the ratio of feedback impedance to the input impedance. There are four ranges of gain available for the range amplifier. Relays K2 through K5 on the A13 assembly select the feedback networks for the corresponding .1 to 100 volt ranges. The 1000 volt range of the instrument is obtained by using the 100 volt feedback network of the range amplifier and passing the output of the amplifier through a 10:1 attenuator selected by de-energizing relay K1 on the A13 assembly. Gain of the digit amplifier is controlled by the A13 assembly feedback networks selected by the 1st through 4th counters and the precounter. The output of the digit amplifier is applied to the T/C amplifier which functions as a voltage to current amplifier that provides current drive to the heater of the ac thermocouple. Gain of the T/C amplifier is stabilized by feedback through the heater of the ac thermocouple. The resulting ac current through the ac thermocouple heater generates a dc output that is in opposition to the output of the dc thermocouple. The dc thermocouple current is derived from the output of zener CR5, a resistive divider, and the calibrate logic circuitry. The self-calibrate logic circuitry is discussed in detail in paragraphs 3-48 and 3-49. Whenever a readout display of less than 40 is obtained, a 5 kHz signal from the A15 Null Detector is applied to the input of the digit amplifier from terminal 1. This signal is then passed through the heater of TC1 as a minimum current signal to prevent cooling of the ac thermocouple. Upon initiation of the self-calibrate cycle or the occurance of an overload, relays K1 and K2 are energized. Relay K1 disconnects the ac thermocouple from the output of the T/C amplifier, and relay K2 applies a dc reference current to the heater. A fixed bias is also applied to the digit amplifier during the self-calibrate or overload condition by the bias gate. Normally this circuit provides additional negative feedback for the digit and T/C amplifiers.

3-43. The outputs of the ac and dc thermocouples are applied to terminals 26 and 27 of the A15 Null Detector assembly. The magnetic modulator/dc amplifier is a very stable high-gain low-noise amplifier that senses the dc voltage difference between the outputs of the ac and dc thermocouples. The output of this amplifier drives the lead amplifier which compensates for the slow response time of the thermocouples. If the instrument is overloaded, the lead amplifier also provides an overload clamp signal to terminal 18. The calibrate relays of the A14 assembly are energized by this signal to prevent offset of the ac thermocouple due to long term overloads. The up-down amplifier is an operational amplifier used to develop a positive input signal to the VCO driver regardless of its input signal polarity. The amplifier also develops a positive or negative UP/DN output used to drive the up-down switch in the A10 Control Logic circuitry. The VCO driver inverts and level shifts the output of the up-down amplifier and applies the resulting signal to the VCO. The VCO generates an output signal having a frequency from 12 Hz to 200 kHz which is proportional to the VCO driver output current. This output frequency signal is then applied to the A10 Control Logic circuitry. Control loop gain gates receive inputs from the decade counters and reduce the gain of the null detector at specific counts of 4000, 1000, 400, and 100, thus maintaining a relative constant loop gain in the main control loop. On counts less than 40, the 5 kHz gate is enabled, providing a 5 kHz output signal to terminal 12. This signal is applied to the input of the digit amplifier as a minimum signal to prevent cooling of the heater of TC1.

3-44. The A10 Control Logic circuitry receives the VCO output signal and, by using a shaper amplifier, converts the signal into a logic level clock signal. The clock signal drives the precounter which produces one output pulse for every eight clock pulses. The precounter output pulses are applied to the carry flip-flop which drives the HI/LO counter and the following A9 0-To-9 Counter, if a sample inhibit pulse is not present, and the HI/LO counter is in the LO mode. Whenever the HI/LO counter receives four precarry input pulses without having had an up down change, it shifts to the HI mode causing the clock pulses to bypass the precounter, thereby driving the carry flip-flop and the following 0-To-9 counter at eight times their normal rate. This increased rate is necessary to expedite reaching a null condition when the detected null error is large. Whenever the UP/DN signal present at terminal 8 passes through zero, the UP/DN flip-flop is triggered by the next clock pulse, producing a reset signal to the HI/LO counter. The HI/LO counter is then set to the LO mode, thus slowing the counting rate at a near null condition. The precounter then resumes counting the clock pulses and the resulting output count used to control selection of feedback networks is the A14 digit amplifier. A N<40 signal at terminal 7 will also reset the HI/LO counter to the LO mode. When the input signal to the UP/DN switch is more negative than -60 millivolts, the UP/DN flip-flop is set to a state that causes the associated circuitry to generate an up-logic command on the UP output terminals of 19 and 21 and a not-down logic command on the DN output terminals of 20 and 22. Whenever the input to the UP/DN switch is greater than +60 millivolts, a down-logic command is generated and applied to the DN lines while a not-up-logic command is applied to the UP lines. These UP or DN signals are then used by the precounter and the following decade counters to control their counting direction. Range gates generate the appropriate RANGE DN or UP commands present at terminals 10 or 11. A RANGE DN command occurs if the first digit is zero and a DN signal is present. A RANGE UP command occurs if the readout is 11999 and an UP signal is present. These RANGE UP or DN commands are used by the A5 Range Logic circuitry to change ranges during automatic range operation of the instrument.

3-45. The 1st through 4th Decade Assemblies count the precarry and carry pulses under the control of the UP and DN gating signals. The 2nd through 4th Decades are 0-9 Counters while the 1st Decade contains a 0-11 counter and provides an overrange digit output to the A5 Range Logic. Since these decade counters differ only in their count sensing gate configurations, only the 4th Decade 0-To-9 Counter will be described.

3-46. Precarry pulses applied to A9 terminal 16 are counted in a binary fashion by a reversible 0-9 counter. This counter is under the control of the UP and DN gating signals present at terminals 21 and 22. Upon

reaching a count of 9, the associated count sensing gate responds to the simultaneous presence of the UP gate at terminal 19 and the counter 9 count and furnishes a 4th Decade 9 and UP signal out terminal 10 to the A10 range gates. The carry flip-flop is then triggered by the count sensing gate on the next count (9 + 1) to provide a carry pulse output at terminal 15 while at the same time resetting the counter to a zero count. The positive portion of the clock pulse present at terminal 17, which corresponds to the 9 + 1 count, resets the carry flip-flop, allowing the counter to resume counting. Upon reaching a count of zero with a DN gate present at terminal 20, the count sensing gates furnish a 4th Decade 0 and DN signal out terminal 10 to the A5 range gates. The carry flip-flop is then triggered by the count sensing gate on the next count (0-1), but the presence of the DN gate causes the counter to be reset to a nine count. The positive portion of the clock pulse present at terminal 17, which corresponds to the 0-1 count, resets the carry flip-flop, allowing the counter to resume counting. Available at terminals 2 through 5, from feedback drivers, is the count of the 0-9 counter. This count information is applied to the A13 Analog Feedback Circuits to control the gain of the digit amplifier. As the count of the counter increases, the gain of the digit amplifier is decreased until a null condition exists between the ac and dc thermocouples. The counter output count is then directly proportional to the measured ac voltage rms value. All that remains now is for the decoders to decode the counter output upon the presence of a sample pulse at terminal 18 and illuminate the corresponding digit in the display tube. Decimal point information is provided at terminal 13 from the A5 Range Logic circuitry.

3-47. The A5 Range Logic circuitry controls the operating range of the instrument, the position of the decimal point, and provides an overrange digit display. The range counter is a three-stage reversible binary counter whose counting direction is controlled by the UP or DN gating signal present at terminals 26 and 27. When either a RANGE UP or DN command is applied to terminal 17 or 18, the range oscillator will provide trigger pulses to the range counter if the RANGE switch is in the AUTO position. The resulting output count of the range counter is then decoded by the range amplifier decoder which in turn causes an output current at either terminal 2, 3, 4, 6, or 7. This output current energizes the appropriate range relay in the A13 Analog Feedback Circuits which controls the gain of the previously discussed range amplifier. An output from terminal 5 is present on the 1, 10, and 100 volt ranges which selects an additional feedback path in the first stage of the range amplifier to reduce its loop gain. When the RANGE switch is placed to a position other than AUTO, the range oscillator is disabled and the range counter is preset by the manual range diode matrix to a count that will select the desired .1, 1, 10, 100, or 1000 range relay. The range buffers store the count of the range counter until a sample enable pulse is present at terminal 25. The sample pulse causes the range buffers to transfer the count of the range counter to the decimal point decoder. An output from the decimal point decoder is then applied out terminal 19, 20, 21, or 22 to illuminate the appropriate decimal point of the 1st through 4th decade indicator. Upon receiving an overrange digit input at terminal 23, the overrange display causes the overrange 1 digit to be illuminated.

3-48. The A13 Analog Feedback Circuits are composed of feedback networks which control the gain of the range and digit amplifiers in the A14 Analog Amplifier Circuits. Selection of the feedback networks for the range amplifier is controlled by energizing relay K2 through K5. Only one of these relays is energized at any one time to select the desired feedback resistance. On the 1000 volt range, the 100 volt feedback path is selected by K5 and a 10:1 attenuator is connected to the output of the range amplifier by de-energizing relay K1. The digit amplifier feedback path consists of parallel resistance networks that are selected by the precounter and 1st through 4th decade counters. Each BCD bit of these counters controls a transistor switch or switches located in each resistive network. As each decade counter increases its count, each BCD output line controls a particular transistor or transistors in the associated resistive network. Total resistance of the feedback network is then changed, appropriately altering the gain of the digit amplifier. The higher the count of the counters, the lower the amplifier gain becomes by the selection of additional resistive networks. This gain adjustment continues until a null exists between the ac and dc thermocouples. When a null is obtained, the counters have tabulated the rms value of the ac voltage present at the input, which is then displayed by the readout tubes.

3-49. The A12 Sample Circuits produce the sample pulse used to transfer the count from the counters in the decade and range circuits to the readout tubes. The sample pulse also suspends all counting during sample time by inhibiting the precarry output of the A10 Control Logic. The sample pulse generator produces a pulse having a repetition time of .1 to 10 seconds. Control of the pulse reoccurence frequency is determined by the position of the DISPLAY TIME-SEC switch and the VERNIER control. The output pulse of the sample pulse generator triggers a single shot multivibrator that produces a 4 millisecond sample pulse at terminal 19. The sample signal is also amplified and used to illuminate the SAMPLE lamp connected to terminal 9, thus providing a visual indication of the sample rate. Whenever the SAMPLE TIME-SEC switch is placed to the 2-10 AUTO CAL position, a pulse at sample time is gated through the cal start flip-flop to terminal 7 and then to the A11 Calibrate Logic circuitry. Two sample pulses are required to cause one pulse out of this flip-flop, therefore, the automatic self-calibration cycle occurs on every other sample pulse. Remote control of the sample rate and self-calibrate cycle is accomplished by applying the appropriate enable and pulse commands at terminals 1, 3, and 4. Two remote commands are required to initiate remote control of the sample circuits. The sample pulse generator must be disabled by a remote sample enable at terminal 4 and the 4 msec multivibrator must be triggered by a remote sample pulse input at terminal 3. The remote sample generator provides the necessary trigger pulse. The self-calibrate cycle can be remotely initiated by applying a remote calibrate signal to terminal 1, which is amplified and applied out terminal 2 to the A11 Calibrate Logic circuitry. Whenever the UP and DN inputs present at

terminals 21 and 22 change from UP to DN or DN to UP and a CALIB LAMP signal is present at terminal 13, the calibrate lamp driver and gate cause the CALIBRATE lamp connected to terminal 16 to illuminate, indicating that the Model 9500A thermocouples are in calibration.

3-50. SELF-CALIBRATE CIRCUITRY. The self-calibrate circuitry adjusts the current flowing in the dc reference thermocouple until it matches a dc reference current passed through the ac thermocouple. This dc current, passing through the ac thermocouple during self-calibration, is equal in heating effect to an ac current through its heater when the count of the counters is equal to the rms value of a measured ac voltage. Refer to paragraphs 3-36 through 3-39 for a simplified description of the self-calibrate circuitry. The following discussion describes the A11 Calibration Logic circuitry.

3-51. Upon initial application of ac power to the instrument, the start-up timer will enable the self-calibrate circuitry for a period of 20-25 seconds and also provide a blanking output at terminal 7. The blanking output prevents +190 volts dc from being applied to the display tubes, thus darkening them during the turn-on self-calibration cycle. One output from the start-up timer places four switching transistors into conduction which provide self-calibrate command out terminals 3, 6, and 8. This same output also provides a CALIB LAMP command to be available at terminal 4. The CALIB RELAY command energizes the calibrate relays in the A14 assembly and the CALIB CLAMP command interrupts the A10 precounter counting process. The VCO CLAMP command is applied to the A15 VCO and establishes a minimum clock output frequency of approximately 12 Hz. Another output of the start-up timer causes the VCO clock input to bypass the first stage of the calibrate logic counter, doubling the speed at which it counts. The calibrate logic counter then counts the VCO clock pulses in the direction determined by UP/DN gates at terminals 16 and 17. The count of the calibrate logic counter determines the current flow at terminal 2 which in turn adds or subtracts from the current through the dc thermocouple heater. When a null condition is obtained between the two thermocouples during self-calibration, the UP/DN gates alternate, holding the counter within one count of its last count. This action maintains the current flow through the dc thermocouple which is close or equal to the detected null current. The previously described A12 Sample Circuits also cause the CALIBRATE lamp to be pulsed on and off whenever self-calibration is achieved, thus providing a visual indication of self-calibration to the operator. After 20 to 25 seconds, the start-up timer outputs return to their quiesent state, ending the turn-on self-calibration cycle. Manual actuation of the self-calibrate cycle can be accomplished at any time after the turn-on self-calibration cycle is completed. Pressing the MAN CALIB switch places terminal 13 at a low which activates the self-calibrate cycle. Total time of the manual self-calibrate cycle is equal to 500 milliseconds or the length of time that the MAN CAL switch is depressed. Upon activation of the self-calibrate cycle, the low input at terminal 13 enables a NAND gate which allows the VCO clock pulse to pass and trigger the calibrate logic counter. The calibrate logic counter then counts up or down under control of the UP or DN gates which in turn varies the dc thermocouple heater current. Completion of the self-calibrate cycle is indicated by pulsing of the CALIBRATE lamp. Remote initiation of the self-calibrate cycle is accomplished through the previously described A12 Sample Circuits. Operation of the remote self-calibrate cycle is identical to that of the manual calibrate cycle. When the DISPLAY TIME-SEC switch is placed to the 2-10 AUTO CAL position, automatic initiation of the self-calibrate cycle occurs after every other sample pulse, provided that the A10 Control Logic circuits are in the LO mode. Simultaneous occurance of these two signals at terminals 5 and 11 trigger the 500 msec timer which in turns causes the self-calibrate cycle to be activated for 500 milliseconds. Function of the circuitry is the same as the previously described manual or remote initated self-calibrate cycle.

3-52. SUMMARY

3-53. The preceding paragraphs were written to give the reader a functional understanding of the Model 9500A using the functional block diagram contained at the rear of this manual and can be summerized as follows:

a. Input ac voltages are amplified or attenuated by analog amplifiers and passed through the heater element of an ac thermocouple. Gain of the analog amplifiers are controlled by feedback networks selected by the BCD outputs of decade counters comprising a null seeking servo system. The resulting outputs of the two differentially connected thermocouples are then applied to the following null detector circuitry.

b. The null detector senses the algebraic sum of the two thermocouple outputs, and from this voltage produces the VCO and UP/DN signals. The VCO signal has a frequency of 12 Hz to 200 kHz, proportional to the magnitude of the detected voltage. The UP/DN signal polarity is related to an ac thermocouple voltage output above or below the dc thermocouple output.

c. The control logic converts the null detector output signals to the logic levels required to drive the BCD counters and also determines the count speed at which they operate. In addition, range up or down commands are also generated on appropriate decade count inputs and applied to the range logic circuitry to control automatic ranging of the instrument.

d. Decade counters, under the control of the UP or DN signals, count their precarry or carry inputs and the resulting BCD outputs are used to select feedback resistance networks in the analog amplifier. As the BCD count increases, the gain of the analog amplifier is decreased until the output of the ac thermocouple matches the dc reference output of the dc thermocouple. A sample pulse then causes the BCD count to be transferred to the readout tubes, thus providing a stable readout for the operator. When the BCD count reaches 0 or 9, range logic commands are generated and applied to the control logic for automatic ranging of the instrument.

e. Range logic circuitry selects the input range of the analog amplifier and positions the readout tube decimal point. Automatic selection of the range and decimal point position is done on command from the control logic when the RANGE switch is in the AUTO position. Manual selection of the range is provided when the RANGE switch is placed to a position other than AUTO.

f. Sample circuits provide an adjustable sample rate of 0.1 to 10 seconds for transfer of the decade counter BCD outputs to the readout display tubes and printer output. When sample rates of 2 to 10 seconds are used, a self-calibrate enable pulse after every other sample pulse is applied to the calibrate logic circuitry. Remote control circuitry for the self-calibrate cycle initiation and sample rate is also provided.

g. Calibration logic circuits provide manual or automatic calibration of the ac and dc thermocouples. Upon initial application of power to the instrument, a start-up calibration cycle of 20 to 25 seconds is accomplished to calibrate the thermocouples. After the start-up calibration cycle is completed, manual or automatic initiation of self-calibration is available. A remote control input from the sample circuit can also be used to initiate self-calibration.

3-54. CIRCUIT ANALYSIS

3-55. INTRODUCTION

3-56. The following paragraphs describe in detail the circuitry contained in the Model 9500A and are presented in the same order as they appeared in the preceding block diagram analysis. Functional Schematic Diagrams of each assembly are located at the rear of this manual.

3-57. ANALOG AMPLIFIER CIRCUITS

3-58. The A14 Analog Amplifier Circuits (Drawing No. 9500A-1014) amplify or attenuate the ac voltage measured with the instrument. This signal is then passed through the heater of an ac thermocouple which generates an output in opposition to the output of a dc thermocouple. Calibration and overload protection circuitry for the ac and dc thermocouples is also provided. The circuitry is comprised of an operational range amplifier, an operational digit amplifier, a thermocouple driver amplifier, thermocouples TC1 and TC2, and self-calibrate-overload circuitry.

3-59. RANGE AMPLIFIER. Measured ac input voltages to the instrument are amplified or attenuated by the Range Amplifier circuits comprised of Q3 through Q7. The input circuit of the Range Amplifier is composed of R169 and C6 which maintain a high input impedance of 1 megohm shunted by less than 17 pf. By placing the input R/C network in the probe, on the probe version instruments, the input to the Range Amplifier is effectively extended the length of the probe cable, thus eliminating the probe cable capacity. Overload protection of the Range Amplifier input circuitry is provided by the diodes CR6 and CR7. Since the input summing junction is driven to zero volts by negative feedback, voltage excursions in excess of 0.7 volts constitute an overload and are shunted to ground by CR6 or CR7. The input stage Q3 is a field effect transistor (FET) utilized for its high input impedance and low noise features. The common-base stage Q4 and the common-emitter stage Q6 provide the necessary voltage gain of the input ac signal. Emitter followers Q5 and Q7 are used for impedance matching. Bias of Q4 and subsequently the remainder of the amplifier circuitry is adjusted with R4. High frequency compensation is provided by negative feedback from the collector of Q6 through C10 to the base of Q5. External negative feedback networks located in the A13 Analog Feedback Circuits assembly are selected with range logic commands from the A5 Range Logic assembly. These feedback networks control the forward gain of the Range Amplifier in 20 db decade steps. On the .1 volt range, the feedback resistance R157 is selected and the network compensated with C3. On the 1 volt range, the impedance of the feedback network is reduced to one tenth the input impedance resulting in one tenth the forward gain. The 10 and 100 volt range feedback networks reduce the forward gain in a similar manner, thus providing four 10:1 steps of gain reduction for the Range Amplifier. The 1000 volt range is provided by using the 100 volt range feedback network and de-energizing relay A13K1. The Range Amplifier output is then attenuated by a factor of ten with the A13 resistive network of R151, R153, and R156. A constant source resistance of 1.8k ohms is maintained at the input of the following digit amplifier by Q38. On the lower ranges, when relay A13K1 is energized, the digit amplifier sees a source resistance of 1.8k ohms. However, when the relay is de-energized on the 1000 volt range, the digit amplifier would see 10k ohms if it were not for Q38. When A13K1 is de-energized, Q38 is brought into conduction, shunting the attenuator output so that the digit amplifier continues to see a source resistance of 1.8k ohms. Voltage offsets introduced by the conduction of Q38 are minimized by its special base-collector bias configuration. The transistor and its matched shunting resistor A13R77 present a constant zero volts, or ground potential, at its emitter when conducting. Control of A13K1 and A13Q38 is provided by A14Q24 which is biased to cut-off on the 1000 volt range. Open loop gain of the Range Amplifier is reduced to prevent oscillations on ranges above .1 volt. This gain reduction is provided by conduction of Q1 on the 1 volt range and Q2 on the 10, 100, and 1000 volt ranges. Command signals for these networks are produced in the A5 Range Logic circuitry.

3-60. DIGIT AMPLIFIER. AC voltages at terminal 13 are amplified by the Digit Amplifier comprised of Q8 through Q14 and its associated feedback networks. The input stage Q8, an emitter-follower, is used for impedance matching to the following stage of Q9. The common-base stages Q9 and Q10 and the common-emitter stage Q12 provide the necessary voltage gain of the ac input signal. Emitter-followers Q11 and Q14 are used for impedance matching. Transistor Q13 provides a low impedance dc bias at the emitter of Q12. Resistors R17 and R22 allow adjustment of the amplifier dc bias levels. Low frequency stabilization of the amplifier circuitry is provided by feedback at the base of Q9. Resistor R65 allows adjustment of the low frequency

compensation. High frequency loop compensation is provided by negative feedback from the collector of Q12 through C19 to the base of Q11. Bootstrap capacitor C18 of the emitter-follower stage Q11 provides additional gain. External negative feedback networks located in the A13 Assembly are selected by logic commands from the A6 through A10 assemblies to control the forward gain of the amplifier such that its gain is inversely proportional to the count of the counters. A small amount of positive feedback from the output of the following thermocouple driver amplifier through TC1, R54, R64, and R23 increases the gain of the Digit Amplifier for low level input signals. Whenever a count of less than 40 is obtained, a 5 kHz signal is applied to terminal 1 and the input of the Digit Amplifier to maintain a minimum current signal through the heater of TC1 and establish a constant operating temperature for the thermocouple. Voltage transients which occur at the output of the Digit Amplifier whenever the 4th Decade one count is either initially obtained or removed are eliminated by conduction of either Q20 or Q28. A change in state of the voltage present at terminal 7 will result in the momentary conduction of either Q20 or Q28 and application of a ground to the junction of R107 and R106 to suppress voltage transients.

3-61. THERMOCOUPLE DRIVER AMPLIFIER. AC output voltages from the preceding digit amplifier are amplified by the Thermocouple Driver Amplifier comprised of Q15 through Q19, Q21, and Q22. The input stage Q15, an emitter-follower, is used for impedance matching to the amplifier Q16. The common-base stage Q16 and the common-emitter stage Q19 provide voltage gain of the drive signal applied to the push-pull output amplifier Q21 and Q22. Emitter-follower Q17 is used for impedance matching. Resistor R44 provides bias adjustment for Q16 and subsequently the remainder of the amplifier circuitry. Transistor Q19 provides a low impedance dc bias at the emitter of Q18. High frequency loop compensation is provided by negative feedback from the collector of Q18 through C23 to the base of Q17. Bootstrap capacitor C22 of the emitter-follower stage of Q17 provides additional gain. Diode CR1, a negative limiter, limits the maximum positive collector voltage swing of Q18. This circuit functions only on excessive inputs that occur during selection of feedback networks in the preceding digit amplifier. The push-pull complementary amplifier comprised of Q21 and Q22 provides a continuous ac signal through the normally closed contacts of K1 and the heater of TC1. This same signal is also applied through Q30, a transistor switch, to the dc bias circuit of Q9 in the digit amplifier and stabilizes the overall dc and low frequency response of both the digit and thermocouple amplifiers. The R/C networks in parallel with the heater element of TC1 provide overall frequency response compensation of all the A14 Analog Amplifier Circuits. Compensation at 30 kHz and below is provided by the selection of values for R87 and C36, while compensation at 700 kHz is provided by selection of values for R88 and C35. Positive feedback through the heater of TC1, R57, and R53 increases the gain of the Thermocouple Driver Amplifier for low level input signals.

3-62. THERMOCOUPLES. Two differentially connected high vacuum thermocouples, designated TC1 and TC2, are used in the Model 9500A to determine the heating effect of the measure ac signal. As the measured ac signal is passed through the heater of TC1, an emf output is generated at its thermocouple junction which is in opposition to the established emf output of TC2. The resulting output voltages present at terminals 3 and 4 are then detected by the following A15 Null Detector circuitry which in turn controls the digital circuitry of the instrument. The gain of the range and digit amplifiers are then increased or decreased until the resulting output of TC1 is equal to the output of TC2. At this point the count of the logic counters contained in the Model 9500A represent the rms value of the measured ac signal.

3-63. SELF-CALIBRATE AND OVERLOAD CIRCUITRY. Upon initiation of a self-calibrate or overload clamp signal, relays K1 and K2 are energized, thereby disconnecting the heater element of TC1 from the output of the thermocouple driver amplifier and applying instead, a dc reference current through the heater of TC1. The same signals also cause a fixed bias to be applied to the digit amplifier. The presence of a ground signal at terminal 8 or 17 forward biases Q23 which in turn energizes relay K1 whose contacts disconnect the heater of TC1 from the output of the thermocouple driver amplifier. Relay K2 is also energized by the ground at terminal 8 or 17, applying a dc reference current through its contacts and the heater of TC1. Conduction of Q23 also drives Q25 and Q26 into conduction, grounding the low frequency feedback network of the digit and thermocouple amplifiers. Transistor Q29 is also forward biased whenever relay K2 is energized, which in turn cuts-off transistor Q30 and disables the associated low frequency feedback network. The A11 Calibrate Logic circuitry then varies the current at terminal 6 until the current flow through the heater of TC2 produces an output to match that of TC1. The dc reference current for TC1 is adjusted with R90 and the selection of the jumpers across R61 through R63. The dc current for TC2 is adjusted with R96, R101, and the selection of jumpers across R97 through R99.

3-64. NULL DETECTOR

3-65. The A15 Null Detector (Drawing No. 9500A-1015) detects the output voltage difference between the two thermocouples and generates a VCO and UP-DN signal corresponding to the magnitude and polarity of the detected voltage. The Null Detector circuitry is comprised of an oscillator, a modulator, a carrier amplifier, a demodulator, a lead amplifier, an UP-DN amplifier, a VCO driver amplifier, a voltage controlled oscillator, a VCO clamp, and control loop gain attenuators.

3-66. OSCILLATOR. The Oscillator circuitry comprised of Q1, Q2, T1, and Q38 produces a 2.5 kHz driving signal for the modulator and a 5 kHz driving signal for the demodulator. Transistors Q1 and Q2 are connected in a push-pull tuned-collector configuration, thus providing a 2.5 kHz output to the modulator free from second-harmonic distortion. The tuned-collector circuit consisting of T1 and C1 determines the frequency of operation. Regenerative feedback is provided to the bases of Q1 and Q2 by the induced secondary voltages of T1. Capacitor C4 places the center-tapped

secondary of T1 at ac ground. The 2.5 kHz signal induced in the associated output winding is applied to the magnetic modulator T3. Amplitude control of the output signal is provided by Q38 which peak detects drive current to the modulator across R10 and applies a control current to the bases of Q1 and Q2. Because transistors Q1 and Q2 are connected in push-pull, the emitter signal developed across R1 is a full-wave rectified 2.5 kHz signal. Since this signal is unfiltered, it appears as a 5 kHz signal at the base of the demodulator driver Q3. This signal is then amplified and used to drive the demodulator Q6. On counts less than 40, the collector signal of Q6 is applied through R31 and R112 to terminal 12 where it is applied to the input of the previously described A14 digit amplifier. On counts above 40, transistor Q41 is forward biased, shorting out the signal present at the junction of R31 and R112.

3-67. MODULATOR. The Modulator consisting of T3 is a magnetic device using the principles of a saturable core to obtain amplification of the thermocouple outputs. Operation of the magnetic modulator is based upon the symmetrical saturation of the control winding by the 2.5 kHz driving signals from the oscillator circuitry. Absence of an input dc control current between terminals 1 and 2 of T3 results in a minimum second harmonic 5 kHz signal in the control winding and the primary of T2. Presence of an input current between terminals 1 and 2 of T3 unbalances the symmetrical saturation pattern resulting in the generation of a 5 kHz signal in the control winding of T3 and the primary of T2. The amplitude and phase of this 5 kHz signal is proportional to the magnitude and direction of current flow in the control winding of T3. Transformer T2 is tuned to the 5 kHz signal and couples the resulting signal to the input of the following carrier amplifier.

3-68. CARRIER AMPLIFIER. The Carrier Amplifier comprised of Q4 and Q5 amplifies the 5 kHz output signal of the magnetic modulator. Capacitor C8 couples the resulting amplified signal to the emitter of the demodulator Q6.

3-69. DEMODULATOR. Transistor Q6 and R18 comprise a synchronous demodulator used to detect the amplitude and polarity information contained in the 5 kHz carrier signal. The synchronous demodulator is driven in synchronism with the magnetic modulator driving signals and is operated in the inverse mode to secure minimum saturation voltage. The resulting dc voltage is developed across R18, filtered by C9, and then applied to the input of the lead amplifier.

3-70. LEAD AMPLIFIER. The Lead Amplifier comprised of Q7 through Q12 compensates for the relatively slow response characteristics of the thermocouples to changes in the level of the measured ac signal. The effect achieved by the use of this amplifier is to provide a phase lead for an exponentially changing input that results in a fast rising dc output equal to the eventual value of the applied input. The R/C feedback network of C10, C11, R22, and R23 controls the response and gain characteristics of differential amplifiers Q7 through Q9. Variable resistor R22 provides adjustment of the amplifier response characteristics. Whenever the output of the lead amplifier exceeds a predetermined overload point of approximately +7 volts dc, transistor Q12 is driven into conduction and applies an overload clamp signal out terminal 18 to the A14 self-calibrate overload circuitry. Transistor Q10 is also driven into conduction during an overload condition to bypass R22 and increase the lead amplifier response characteristics.

3-71. UP-DN AMPLIFIER. The UP-DN Amplifier comprised of Q13 through Q16 and associated feedback networks is an operational amplifier utilized to amplify the output voltages of the preceding lead amplifier. Input voltages to the UP-DN Amplifier are amplified by the differential amplifiers comprised of Q13, Q14 and Q15. Transistor Q16 is an output driver amplifier. Overall gain of the UP-DN Amplifier is controlled by negative feedback through CR3 and R46 or CR4 and R48, depending on the polarity of the output signal. The signal appearing at the collector of Q16 will be negative, if the input is positive, and will range from zero to -4 volts depending on the input to the amplifier. Negative inputs to the UP-DN Amplifier result in a zero to +4 volts output signal at the collector of Q16. These voltage signals are applied out terminal 16 to provide the UP-DN drive signals for the A10 Control Logic circuitry.

3-72. VCO DRIVER AMPLIFIER. The VCO Driver Amplifier comprised of Q19 through Q22, Q24, and Q26 is an operational amplifier used to provide frequency control currents for the following VCO. Whenever the input to the preceding UP-DN amplifier is positive, a current drive input to Q19 is provided through resistor R52. Negative inputs to the UP-DN Amplifier result in conduction of CR4 and a current drive input to Q19 is provided through resistor R49. Consequently, regardless of the signal polarity at the input of the UP-DN amplifier, the current drive input to Q19 is in only one direction. The current drive input to Q19 is amplified by the differential amplifiers comprised of Q19 and Q20, and the inverter Q22. Transistors Q24 and Q26 are the output drivers. Overall gain of the VCO Driver Amplifier is controlled by negative feedback through networks located in the emitter circuits of Q24 and Q26.

3-73. VOLTAGE CONTROLLED OSCILLATOR. The Voltage Controlled Oscillator comprised of Q28 through Q34 is a free-running multivibrator having a frequency range of 12 Hz to 200 kHz. Control of the VCO output frequency is provided by the drive currents through Q24 and Q26 to the cross-connected R/C networks of C14, R101, and C15, R100. Resistors R95 and R96 determine the low frequency limit of the VCO. Transistor Q34 provides operating voltage at the emitters of Q32 and Q33. The resulting output signal at the emitter of Q28 is applied through a jumper to terminal 17 where it is then applied to the following A10 Control Logic circuitry. The jumper provides a means of interrupting the control loop of the instrument.

3-74. VCO CLAMP. The VCO Clamp of Q27 is biased into conduction during the self-calibrate cycle by a low logic command at terminal 20. Conduction of Q27 limits the drive currents applied to the VCO at its minimum value, thereby providing a VCO output frequency of approximately 12 Hz during the self-calibration cycle.

3-75. CONTROL LOOP GAIN ATTENUATORS. Input logic signals at terminals 1 through 8 and 13 through 15

from the following Decade Counters are used to reduce the overall gain of the Null Detector at specific counts and improve the loop response. These logic signals are applied to diode gates which drive Control Loop Gain Attenuators at specific counts of 100, 400, and 4000. An additional gate is also used to switch the 5 kHz to the A14 digit amplifier on counts less than 40. The gain attenuators controlled by Q23 and Q25 function on a count of 1000 and 4000 to reduce the gain of the VCO Driver Amplifier. The gain attenuators controlled by Q17 and Q18 function on a count of 100 and 400 to reduce the input voltage applied to the UP-DN Amplifier. Their output is also fixed when the instrument is in the self-calibrate cycle by conduction of Q39, Q40, and Q42.

3-76. CONTROL LOGIC

3-77. The A10 Control Logic (Drawing No. 9500A-1010) converts the VCO and UP/DN inputs into the logic levels required to drive the digital circuitry contained in this instrument, while at the same time performing last digit counting as a null is approached between the ac and dc thermocouple outputs. Range control gates also provide logic commands to the A5 Range Logic necessary to change the range either upward or downward. The circuitry is comprised of an UP/DN switch, a shaper and clock pulse control gate, a precounter, a carry flip-flop, a HI/LO counter, and decade limit sensing and range control gates.

3-78. Two different circuit configurations, micrologic or dual inline, are used in the Model 9500A. Consequently, two different schematics for all of the following circuits are contained at the rear of this manual. Refer to the serial number information contained in the schematic diagram title block to determine which schematic applies to your instrument. Reference designations have been omitted in the following discussions in order to cover both configurations.

3-79. UP/DN SWITCH. The UP/DN Switch senses the output level of the previously described A15 UP/DN amplifier and generates an up-down logic output signal or a reset signal used by the HI/LO counter. Input voltages applied to terminal 8 are amplified and shaped to a logic level with an emitter-coupled limiter amplifier. The resulting signal is then directly applied to the S (set) input of a flip-flop while an amplifier inverts the signal applied to the C (clear) input terminal. Input voltage signals above +60 millivolts at terminal 8 result in the flip-flop being set to a state that, when inverted by the following amplifiers, produces respective not-up and DN (H) output signals at terminals 19 and 20. Input voltage signals more negative than -60 millivolts cause the output of the flip-flop to be reversed, producing respective UP (H) and a not-down output signals at terminals 19 and 20. When the input voltage at terminal 8 is at null (between ±60 millivolts), the flip-flop is triggered by each clock signal resulting in the UP/DN output signals occuring at the clock rate. This signal constitutes a transfer signal for the HI/LO NAND gate which resets the HI/LO counter to the LO mode. The output of the UP/DN switch flip-flop is inverted by two associated transistor amplifiers and the resulting signals used to provide the precounter and terminal 21 and 22 UP and DN GATE signals.

3-80. SHAPER AND CLOCK PULSE CONTROL GATES. The Shaper and Clock Pulse Control Gates convert the VCO input signal to the logic level necessary to drive the digital counters and also control the application of the clock pulses to the precounter. The VCO input signal present at terminal 9 is applied through an emitter-follower to a driver amplifier. The emitter-follower provides the necessary level shift of the VCO signal applied to the driver amplifier. The resulting binary clock signal output is then applied to the associated circuitry and also to terminal 17 where it is used as the master timing CLOCK signal for the counting circuits. Buffer amplifiers provide inversion for the clock pulse signal that are applied to the UP/DN switch and clock pulse control gate. The clock pulse control NAND gate functions upon the simultaneous presence of two low inputs, passing the clock pulse signal to the input of the precounter. However, if the input to the NAND gate from the decade limit sensing gates is high, as is the case during up ranging, the clock pulse is blocked by the NAND gate. During the self-calibrate cycle or down ranging, the output of the NAND gate is driven to a low, effectively blocking the clock pulse inputs to the precounter and carry flip-flop. A CALIB CLAMP command at terminal 3 during self-calibration drives the signal to a low while an amplifier inverts the high RANGE DN command of terminal 10 to provide the low signal during ranging. The signal at terminal 10 is clamped to a low during manual range selection by the A5 Range Logic circuitry to permit operation below one tenth (0999) range.

3-81. PRECOUNTER. The Precounter is a reversible binary octal counter which produces one output for every eight inputs. Since the operation of the Precounter is essentially the same as a BCD counter, the detailed discussion contained in paragraphs 3-29 and 3-30 should afford sufficient understanding of the Precounter circuitry. High (7-UP) and low (0-DN) count sensing gates cause the carry flip-flop to generate a precount carry pulse at terminal 16, if the HI/LO counter is in the low mode and if a SAMPLE pulse is not present at terminal 18. Feedback drivers transfer the Precounter count to terminals 4, 5, and 6 where it is used to select feedback networks in the A13 assembly. A high input from the HI/LO counter or the presence of a sample pulse to the high low count sensing gates prevents transfer of the gates output signal to the carry flip-flop. The presence of a SAMPLE pulse at terminal 18 also stops counting of the Precounter during sampling.

3-82. CARRY FLIP-FLOP. The Carry Flip-Flop produces one output pulse for every eight clock pulse as long as the HI/LO counter is in the low mode. If the HI/LO counter is in the high mode, the Carry Flip-Flop C (clear) input is low, thereby causing its output to shift at the clock rate. When the Carry Flip-Flop output occurs at the clock rate, the counting process is increased to eight times the normal in order to expedite reaching a null condition faster. Eight times the normal rate is realized when we recall that the precounter normally supplies one pulse to the Carry Flip-Flop for every eight inputs from the clock signal. The output of the Carry Flip-Flop is applied out terminal 16 to the following 4th decade counter and also drives the HI/LO counter.

3-83. HI/LO COUNTER. The HI/LO Counter controls the response of the counting loop by keeping it in the low mode during near-null conditions or by shifting to a high mode when a far-from-null condition is apparent. Whenever the UP/DN switch flip-flop changes its output state, the HI/LO Counter NAND gate functions, presetting the HI/LO Counter to the low mode. The HI/LO Counter then counts the carry flip-flop precount carry pulses. Upon receiving the fourth precount carry pulse without an UP/DN transfer it produces a low output to the precounter count sensing gates, bypassing the precounter output to the carry flip-flop. The following decade counter is then driven at eight times the normal rate until the UP/DN switch output changes state, at which time the HI/LO Counter is preset to the low mode. The precounter count sensing gates output then controls the function of the carry flip-flop, and low mode counting is resumed by the HI/LO Counter. The HI/LO Counter is also preset to a low mode when a less than 40 count signal is present at terminal 7.

3-84. DECADE LIMIT SENSING AND RANGE CONTROL GATES. The Decade Limit Sensing Gates function upon the simultaneous presence of low inputs at terminals 12 through 15. These inputs correspond to 1st through 4th decade counts of 11-9-9-9 during up counting, or 0-0-0-0 during down counting. The resulting high output is applied to the clock pulse control gate and the range control gate inverter. A high input to the clock pulse control gate blocks the clock pulse signal to the precounter and carry flip-flop, suspending counting during range changing. Range Control Gates function upon the simultaneous presence of the high outputs from the Decade Sensing Gates and the associated UP-DN gate signal. The high output of the Decade Limit Sensing Gate is inverted to a low and compared to the DN signal present at terminal 20 by the range up gate. If a low not-down signal is present, the Range Control Gate generates a high RANGE UP command at terminal 11 to provide automatic up ranging (if used) for the instrument. A low input at terminal 15 from the 1st decade is compared to the UP signal present at terminal 19 by the range down gate. If a low not-up signal is present, the Range Control Gate generates a high RANGE DN command at terminal 10 thus providing down ranging at readout counts of 0999 which is the count at one tenth range. The resulting signal also acts through a transistor switch to block the clock pulse to the precounter and carry flip-flop during the down range cycle. Whenever the RANGE switch is placed to a position other than AUTO, the signal at terminal 10 is clamped to a low, allowing the use of the lower tenth portion of the selected range.

3-85. DECADE COUNTERS

3-86. Four Decade Counters (A6 through A9) are used to form a four digit counter with an overrange digit in the first decade. The 1st Decade Counter (Drawing No. 9500A-1006) is a 0-To-11 Counter and the 2nd through 4th Decade Counters (Drawing No. 9500A-1007) are 0-To-9 Counters. Each Decade Counter operates in a similar manner, except for the count sensing gates of the 0-To-11 Counter, and count the precarry or carry pulses from the preceding circuit under the control of the UP/DN GATE signals. A display tube on each Decade Counter indicates the BCD count to the operator while feedback drivers transfer the output count to the A13 Analog Feedback Circuit assembly to control the gain of the A14 digit amplifier. The counter circuitry is comprised of a counter, count sensing transfer gates and carry flip-flop, drivers and buffers, and the decoder and display circuits. Since the operation of the 0-To-9 and 0-To-11 Counters is essentially the same, only the 0-To-9 Counter will be described.

3-87. COUNTER. The Counter is a reversible BCD Counter comprised of four flip-flops interconnected by R/C NAND gates. A detailed discussion of the decade counter is contained in paragraphs 3-29 and 3-30. The Counter counts the precarry or carry trigger pulses applied to terminal 16 in a direction determined by the presence of the UP or DN GATE signals at terminals 21 or 22. Outputs from the Counter are applied in BCD code to the readout buffers, feedback drivers, and count sensing gates.

3-88. COUNT SENSING TRANSFER GATES AND CARRY FLIP-FLOP. Low (0 count) and high (9 count) Count Sensing Gates generate a low 0-DN or 9-UP output to the A10 Control Logic upon reaching the count of 0 or 9. The Carry Flip-Flop is then triggered on the next input pulse, generating a carry pulse output to the following decade counter and resetting the counter to the appropriate 0 or 9 count. When a count of 9 is reached on an up counting sequence, the Count Sensing Gate responds to the counter output count and the UP (H) command from terminal 19, producing a low 9-UP output at terminal 10 and a low to the C (clear) terminal of the Carry Flip-Flop. The next trigger input pulse at terminal 16 triggers the Carry Flip-Flop, which is then reset by the next clock pulse at terminal 17. A carry pulse is generated at terminal 15 by this action, which at the same time resets the counter to a zero count through a Transfer Gate. When a count of zero is reached on a down counting sequence, the Count Sensing Gate responds to the counter output count, and the DN (H) command from terminal 20, resulting in the same signal condition previously described to be present at terminals 10 and 15. However, the presence of the DN (H) command at the Transfer Gate causes the counter to be reset to a 9 count.

3-89. DRIVERS AND BUFFERS. Feedback Drivers invert and transfer the BCD output of the counter to terminals 2 through 5. The resulting signals are then used to select feedback networks in the A13 assembly which in turn controls the gain of the A14 digit amplifier. Readout Buffers provide stable unchanging outputs to the Printer Output Drivers and the decoder and display circuits. Each Readout Buffer flip-flop transfers the count from the counter to the associated circuitry upon the occurance of a SAMPLE pulse at terminal 18. The buffers then hold the resulting output count until the next SAMPLE pulse. The Printer Output Drivers provide the printer outputs at terminals 6 through 9.

3-90. DECODER AND DISPLAY. The Decoders translate the binary count registered in the readout buffers to control signals which light the appropriate numeral in the display tube. When the readout buffer output drives the appropriate transistor switch into conduction, the cathode of the desired numeral is driven to ground

causing the associated numeral to become ionized and illuminated. For an example, when the numeral 2 is illuminated, the count received through the buffers from the counter corresponds to $\overline{1}$-2-$\overline{4}$-$\overline{8}$. These signals provide a ground to the emitter of the numeral 2 transistor switch and a high to its base which biases the transistor into conduction. Conduction of the transistor applies a ground to the numeral 2 cathode causing the numeral to be illuminated. Decimal point illumination is provided if a low input is present a terminal 13. Early model units had a pre-bias resistor connected to each numeral cathode. Higher voltage transistors used in late models eliminated the need for the pre-bias resistors.

3-91. RANGE LOGIC

3-92. The A5 Range Logic (Drawing No. 9500A-1005) controls the operating range of the instrument, position of the display decimal point, and provides an overrange digit display. The circuitry is comprised of a range oscillator, a range counter, a manual range diode matrix, buffers and drivers, range decoders, range limit gates, a decimal point decoder, and an overrange display.

3-93. RANGE OSCILLATOR. The Range Oscillator, when enabled by RANGE UP or DN logic commands, produces trigger pulses at approximately 3 Hz to the range counter during automatic ranging. Whenever a high logic command is applied to terminal 17 or 18 the Range Oscillator is enabled, provided the RANGE switch is in the AUTO position. A high signal to either input of the NAND gate drives the following transistor switch into cut-off, which in turn removes the ground from the emitter of the unijunction transistor, allowing the Range Oscillator to function. When the RANGE switch is a placed to a position other than AUTO, another similar transistor switch will place a ground on the emitter of the unijunction transistor, disabling the Range Oscillator during manual range selection. The presence of a SAMPLE pulse at terminal 25 will also disable the Range Oscillator by turning on a transistor switch that removes the supply voltage to the Range Oscillator. A unijunction transistor is employed in the Range Oscillator to form a relaxation oscillator operating at a stable fixed frequency. The capacitor in the emitter circuit of the unijunction will charge toward the supply voltage at an exponential rate until its voltage reaches approximately 62% of the voltage present at the unijunction Base #2. Current will then flow from the unijunction Base #1 to the emitter, discharging the emitter capacitor which in turn cuts off the unijunction. This process then repeats itself, developing a sawtooth waveform in the emitter circuit and a pulse waveform at Base #1. The positive pulse at Base #1 is buffered and applied as a trigger pulse to the following range counter.

3-94. RANGE COUNTER. The Range Counter is a reversible binary octal counter that produces an output binary count used to control the position of the readout decimal point and selection of the input voltage range of the instrument. Since operation of the Range Counter is essentially the same as a BCD counter, the detailed discussion contained in paragraphs 3-29 and 3-30 should afford sufficient understanding of the Range Counter circuitry.

3-95. MANUAL RANGE DIODE MATRIX. The Manual Range Diode Matrix allows presetting the output count of the counter to a desired count, while at the same time disabling the range oscillator. When the RANGE switch is placed to a position other than AUTO, a positive voltage present at terminal 8, 9, 10, 11, or 12 forward biases diode gates to preset the range counter flip-flops at a particular binary count. The range oscillator is also disabled by the conduction of a transistor switch controlled by the diode gates. An additional transistor switch also clamps the signal present at terminal 17 to a low during manual ranging, allowing use of the lower tenth portion of the selected range.

3-96. BUFFERS AND DRIVERS. Buffer flip-flops provide stable unchanging outputs to the decimal point decoder and printer output drivers. Each Buffer flip-flop transfers the count from the range counter to the associated circuitry upon the presence of a SAMPLE pulse at terminal 25. The flip-flops then hold the resulting output count until the next SAMPLE pulse. The Printer Output Drivers transfer the Buffer outputs to terminals 14 through 16 for use with the printer output options.

3-97. RANGE DECODERS. The Range Decoders Translate the range counter output count to the transistor switches that are used to energize or de-energize the range relays in the A13 Analog Feedback Circuits. An additional control signal on the 10 through 1000 volt range is developed at terminal 5 to reduce the open loop gain of the A14 Range amplifier. The signal present at terminal 3 on the 1 volt range is also used for the same purpose.

3-98. RANGE LIMIT GATES. Range Limit Gates function upon the presence of the .1 or 1000 volt output commands from the range decoders. Whenever a .1 volt range is selected, the signal present at terminal 17 is clamped to a low, preventing further down ranging by the logic circuitry. When the 1000 volt range is selected, the signal present at terminal 18 is clamped to a low to prevent further up ranging.

3-99. DECIMAL POINT DECODER. The Decimal Point Decoder translates the binary count registered in the buffers to control signals which cause the appropriate decimal point in the display tubes to illuminate. Each decimal point in the display tubes is illuminated by the conduction of the appropriate transistor switch in the Decimal Point Decoder. Whenever the transistor switch is driven into conduction, a ground is applied to the appropriate display tube decimal point causing the decimal point to become illuminated.

3-100. OVERRANGE DISPLAY. Overranging features of the instrument are provided with the Overrange Display circuitry. Normally the 0 digit cathode of the display tube is held at ground potential by the conduction of the associated transistor switch, causing the 0 digit to be illuminated. However, the presence of a low overrange command at terminal 23 biases the transistor to cut-off, extinguishing the 0 digit and illuminating the 1 digit.

3-101. ANALOG FEEDBACK CIRCUITS

3-102. The A13 Analog Feedback Circuits assembly is comprised of feedback networks used to control the gain of the A14 range and digit amplifiers. The range amplifier feedback networks and associated circuitry are located on the Analog Amplifier Circuits (Drawing No. 9500A-1014) and are described in detail in paragraph 3-59. The digit amplifier feedback networks are located on the Analog Feedback Circuits (Drawing No. 9500A-1013) and are described in the following paragraphs.

3-103. The analog feedback networks consist of resistance networks that are placed in various parallel combinations determined by the BCD count of the decade counters. Total feedback of the digit amplifier is then controlled so that its gain is always inversely proportional to the decade counters output count. For example, when the 1st Decade output count contains an 8 digit, a low signal will be present at terminal 6. This low signal causes Q3 to decrease its conduction, biasing Q1, Q2, and Q36 into cut-off and turning on Q31. Cutting-off Q1, Q2, and Q36 removes the grounds from the feedback network placing it in the feedback path of the digit amplifier. Conduction of Q31 establishes the correct load to ground on the digit amplifier input. Transistor Q31 is connected in a special base-collector bias configuration so that with its matched shunting resistor R170 it presents zero volts at its emitter when conducting, thus introducing minimum offset voltage to the input of the digit amplifier. On successively lower decade digit outputs, this problem diminishes because the feedback resistance values increase to a point where high grounded-to-open resistance ratios exist.

3-104. SAMPLE CIRCUITS

3-105. The A12 Sample Circuits (Drawing No. 9500A-1012) produces the SAMPLE pulse used to transfer the count of the buffers to the display tubes, and the calibrate start pulse which initiates the automatic self-calibrate cycle. Additional circuits provide remote control of the sample rate and illumination of the SAMPLE and CALIBRATE lamps. The circuitry is comprised of a sample pulse generator, a 4 msec multivibrator, a remote sample pulse generator, a calibrate start circuit, a calibrate lamp gate driver, and a remote calibrate driver.

3-106. SAMPLE PULSE GENERATOR. The Sample Pulse Generator employs a unijunction transistor to form a relaxation oscillator similar to the one used in the A5 Range Logic circuitry. The pulse repetition frequency can be continuously varied within a .1 to 10 second range by manipulation of the front panel VERNIER control. Adjustment of this control varies the charge-rate of the unijunction emitter capacitor and consequently the PRF of the pulse present at its Base #1. This output PRF rate is divided into two ranges that are selected with the DISPLAY TIME-SEC switch. Only one capacitor is used in the unijunction emitter circuit on the .1 to 2 second range, while two additional capacitors are switched in parallel with the first to provide the 2 to 10 second range. Two transistor amplifiers, which are located adjacent to the emitter circuit of the unijunction, raise the capacitor voltage to the firing point of the unijunction transistor immediately after the capacitor has changed to 6.25 volts dc, thus reducing circuit timing tolerances. The resulting Base #1 positive output pulse is then used to trigger the following 4 msec multivibrator.

3-107. THE 4 MSEC MULTIVIBRATOR. The 4 MSEC Multivibrator consists of an inverting amplifier and a NAND gate cross connected to form a monostable multivibrator. A trigger pulse input to the inverting amplifier drives its output to a low where it will remain for four milliseconds. The output pulse width is determined by the R/C components at the NAND gate input. After four milliseconds the R/C network discharges sufficiently to enable the NAND gate which applies a low input to the inverting amplifier. This low input returns the amplifier output to a high where it will remain until the next input trigger. The resulting four millisecond pulse is amplified and inverted and applied out terminal 19 as the SAMPLE pulse. This same signal also triggers a transistor switch that discharges the sample pulse generator timing capacitor during the SAMPLE pulse time, and a driver which illuminates the SAMPLE lamp connected to terminals 9 and 15. The calibrate start flip-flop is triggered on each SAMPLE pulse which gates the CALIB START signal during every other SAMPLE pulse.

3-108. REMOTE SAMPLE PULSE GENERATOR. The Remote Sample Pulse Generator consists of two NAND gates cross connected to form a bi-stable multivibrator. The purpose of this circuit is to remove pulse width restrictions on the remote sample enable pulse. Two remote logic commands at terminal 3 and 4 are required to trigger the Remote Sample Pulse Generator. A transistor NAND gate functions upon the simultaneous presence of two high remote sample commands, providing a low trigger input to the bi-stable multivibrator. A transistor switch is also turned on by the presence of a high signal to terminal 4 which disables the sample pulse generator. Triggering of the Remote Sample Pulse Generator provides a low input to the previously described 4 millisecond multivibrator which then produces its 4 millisecond SAMPLE pulse. Upon completion of the output pulse, the low output of the 4 millisecond multivibrator NAND gate sets the Remote Sample Pulse Generator back to its quiescent state, allowing it to function upon the receipt of the next remote sample command at terminal 3.

3-109. CALIBRATE START CIRCUIT. The Calibrate Start Circuit comprised of a flip-flop and a transistor NAND gate provides a CALIB START command output during every second SAMPLE pulse. The first SAMPLE pulse trailing edge triggers the flip-flop to a state that provides a low to the emitter of the associated transistor NAND gate. The next output pulse from the sample pulse generator, which corresponds to the start of the second SAMPLE pulse, causes the transistor NAND gate to function, providing a CALIB START command out terminal 7. The trailing edge of the second SAMPLE pulse sets the Calibrate Start Flip-Flop to the opposite output state which disables the NAND gate during the third SAMPLE pulse output. The third SAMPLE pulse output again places a low at the emitter of

the NAND gate, allowing the fourth sample pulse generator output to produce the second CALIB START command at terminal 7. When the DISPLAY TIME-SEC switch is placed to the 2-10 AUTO position, the resulting signal is applied through the switch to automatically trigger the self-calibrate cycle on every other sample pulse.

3-110. CALIBRATE LAMP GATE DRIVER. The Calibrate Lamp Gate Driver provides illumination of the CALIBRATE lamp whenever the self-calibration is complete. Whenever the self-calibrate cycle is initiated, the high CALIB LAMP command present at terminal 13 is applied to the base of two transistors. One is the input driver to the switching circuits and the other is the output gate. The input switch driver inverts the signal and applies the resulting low to the emitters of two transistor switches. Conduction of these transistor switches is controlled by the presence of the UP and DN signals at terminals 21 and 22. When a null condition is reached during self-calibration, the UP and DN signals alternate back and forth. Each time a change occurs, one of the associated transistor switches turns-off and the resulting capacitor voltage turns-on the CALIBRATE lamp for a short time. Rapid pulsing of the CALIBRATE lamp indicates that the thermocouples are self-calibrated.

3-111. REMOTE CALIBRATE DRIVER. The Remote Calibrate Driver inverts the high remote calibrate input applied to terminal 1 providing a constant level low output at terminal 2. This signal is then used by the A11 Calibration Logic to initiate the self-calibrate cycle.

3-112. CALIBRATION LOGIC

3-113. The All Calibration Logic (Drawing No. 9500A-1011) circuitry provides the logic commands and dc current necessary to initiate and control the self-calibrate cycle of the instrument. The circuitry is composed of a start-up timer, a counter input gate, a calibrate timer, and a logic counter.

3-114. START-UP TIMER. The Start-Up Timer functions only upon instrument turn-on to provide a start-up calibration cycle of 20 to 25 seconds. Upon turn-on of the instrument, emitter current of the unijunction transistor is prevented for approximately 20 to 25 seconds by the transistor located in its emitter circuit. Base voltage of this transistor is raised as the timing capacitor charges until the unijunction fires after 20 to 25 seconds. With the unijunction initially at low conduction, the following amplifier is also cut-off, supplying a high voltage to the bases of three transistor switches that biases them into conduction. One of the transistor switches provides a low voltage to the calibrate timer and logic command drivers, enabling the counter input NAND gate and providing the calibrate logic commands out terminals 3, 4, 6, and 8. A second transistor switch provides a BLANKING command output at terminal 7 to the A1 Power Supply A assembly. This blanking command reduces the +190 volt dc voltage applied to the display tubes to approximately 100 volts dc, causing them to be darkened during the turn-on calibration cycle. A third transistor switch allows the counter input gate signal to bypass the first stage of the calibrate logic counter, doubling the speed at which it counts. After approximately 20 to 25 seconds, the base voltage of the transistor located in the emitter circuit of the unijunction transistor reaches a high enough potential to bias it into conduction. Conduction of this transistor causes the unijunction to conduct at a higher level, producing a high at its Base #1. This high base signal biases the three previously described transistor switches to cut-off, ending the turn-on calibration cycle. Once the unijunction fires, its emitter current is held at the new level by conduction of the associated emitter transistor until power is removed from the instrument.

3-115. COUNTER INPUT GATE. During the self-calibrate cycle, the VCO CLOCK signal is clamped to 12 Hz by the CLAMP command at terminal 8, and a low signal from the start-up timer or calibrate timer is applied to the Counter Input Gate. This low signal and the presence of the CLOCK signal low excursions cause the NAND gate to function, passing the CLOCK signal through a buffer to the following calibrate logic counter. At the end of the self-calibrate cycle, the low input from the calibrate timer or start-up timer goes high, preventing the CLOCK signal from passing through the NAND gate. Absence of a CLOCK input signal to the counter allows the output count to remain unchanged until the next self-calibrate cycle.

3-116. CALIBRATE TIMER. The Calibrate Timer produces the 500 millisecond low signal used to initiate the automatic self-calibrate cycle. Triggering of the Calibrate Timer is accomplished by the simultaneous presence of two low signals at terminals 5 and 11. Triggering of the flip-flop places a low at terminal 13 which initiates the self-calibrate cycle. This low signal biases a transistor switch to cut-off, which removes a ground from the center of an R/C timing circuit in the Calibrate Timer. The R/C network then commences to charge and after 500 milliseconds turns on two transistor switches that preset the timer flip-flop output to a high, ending the self-calibrate cycle. The R/C network is then discharged through the transistor switch turned on by the high output of the timer flip-flop, and the circuit is ready for the next 500 millisecond cycle. Manual operation of the CALIBRATE switch pulls the terminal 13 voltage to a low and places the instrument in self-calibrate. The instrument will remain in self-calibrate for 500 milliseconds or as long as the CALIBRATE switch is depressed.

3-117. CALIBRATE LOGIC COUNTER. The Calibrate Logic Counter is a nine stage UP/DN binary counter whose output count is used to select parallel resistance combinations that determines the dc thermocouple heater current. Since operation of this counter is similar to that of a reversible BCD counter, the detailed discussion contained in paragraphs 3-29 and 3-30 should afford sufficient understanding of the counter circuitry. The system CLOCK signal, which is clamped at 12 Hz during the self-calibrate cycle, is applied to the first stage of the counter. The counter then counts the CLOCK signal in the direction determined by the presence of the UP or DN GATE signals at terminals 16 or 17 until a null is reached, at which time the UP/DN signals alternate

back and forth to hold the count within one digit. The resulting binary count will then remain unchanged until the next self-calibrate cycle. The output count of the counter is used to select parallel combinations of resistors through associated transistor switches that determines the available dc current at terminal 2. Each resistive network value is half of the preceding network, resulting in the dc thermocouple heater current being inversely proportional to the counter binary output count. The current at terminal 2 then adds or subtracts from the current through the dc thermocouple heater until a null is obtained or the self-calibrate cycle is ended.

3-118. POWER SUPPLIES

3-119. The A1 Power Supply A and the A2 Power Supply B assemblies (Drawing No. 9500A-1001) provide the unregulated and regulated dc voltages necessary to operate the instrument. Each regulator circuit contains a current limiter that protects the circuitry from momentary current overloads. Power Supply A provides a regulated +3.6 volts dc to the logic circuits and +190 volts dc to the display tube anodes, while also providing an unregulated +100 volts dc to the CALIBRATE and SAMPLE lamps. Power Supply B provides the regulated +6.5 volts dc and current source for the thermocouples and self-calibrate circuits, and the +13.6 and ±15 volts dc used for operating voltages throughout the instrument.

3-120. AC INPUT VOLTAGE. Input power of either 115 or 230 volts ac is applied to the primary of the input power transformer through the contacts of the POWER SWITCH. The primary winding of T1 is constructed in such a manner as to allow the instrument to be operated from 115 volts ac, windings in parallel, or 230 volts ac, windings in series. Fuse F1 protects the instrument circuitry from overloads. Three windings comprise the secondary of T1 and supply the A1 and A2 Power Supply assemblies with the required ac input voltages. Whenever an ac voltage is present between terminals 8 and 10, the POWER ON LAMP will illuminate indicating application of input power to the instrument.

3-121. POWER SUPPLY A. The ac input voltage applied between terminals 21 and 22 is full-wave rectified by CR5 and CR6 and filtered by capacitor C1 connected to terminals 13 and 14. The resulting dc voltage is then applied to the +3.6 volt dc regulator comprised of Q1 through Q4 and an externally mounted series-pass transistor Q1. Transistor Q3 and Q4 form a differential comparison amplifier, and Q2 is the series-pass driver. Momentary current overloads are prevented from damaging the regulator circuits by the current limiter circuit of Q1. The resistive divider R3 and R4 provides a sample of the regulator output voltage to the base of Q3, and the resistive divider of R6 and R7 provides a dc reference voltage to the base of Q4 derived from the A2 +15 volt supply. The output of the differentially connected comparison amplifier controls the conduction of the series-pass driver Q2, which in turn controls conduction of the series-pass transistor Q1. Conduction of the externally mounted Q1 determines the output voltage of the regulator circuit.

3-122. In order to better understand the regulator circuitry, assume that a decrease in load resistance occurs resulting in a corresponding decrease in the output voltage to be sensed at the base of Q3. Since the base of Q4 is held at a constant reference voltage, the decrease in base voltage of Q3 will cause Q4 to increase its conduction and decrease the positive voltage present at the base of Q2. Conduction of Q2 is increased by this action, which in turn increases the conduction of the series-pass transistor Q1 and returns the output voltage to +3.6 volts dc.

3-123. Momentary short circuits at the regulator output, such as those that might be caused during maintenance procedures, are prevented from damaging the regulator circuitry by the conduction of Q1. Excessive current through R1 and R13 will forward bias Q1 which decreases the conduction of Q2 and the externally mounted series-pass transistor Q1. The regulator output is reduced by this action, limiting the available output current to approximately four amperes.

3-124. The ac input voltage applied between terminals 19 and 20 is rectified by the bridge rectifier comprised of CR1 through CR4 and capacitor C6. The resulting dc voltage is applied to the +190 volt dc regulator circuitry and divided across R14 and R15. The voltage at the junction of R14 and R15 is used to provide an unregulated +100 volt dc output at terminal 10. The +190 volt regulator is comprised of transistors Q5 through Q7, CR7 and CR8, and associated resistors. Transistor Q5 is the series-pass element, and Q7 is a comparison amplifier referenced to +15 volts dc derived from the A2 Power Supply B. Momentary current overloads are prevented from damaging the regulator circuits with Q6. The resistive divider of R10 and R11 provides a sample of the regulator output voltage to the base of Q7 whose emitter is referenced to +15 volts dc. Conduction of the comparison amplifier controls the conduction of the series-pass transistor Q5, which in turn establishes the +190 volt dc output at terminal 16. During the start-up calibrate cycle, a ground is applied to terminal 9 to forward bias CR7 and reverse bias CR8. The conduction of CR7 clamps the emitter of Q7 to ground resulting in maximum conduction of Q7, which in turn reduces the conduction of Q5 to the point where only 80 to 120 volts dc is available at terminal 16. Since this output voltage is used by the display tubes, the display will remain darkened during the start-up calibrate-cycle.

3-125. Momentary short circuits at the regulator output are prevented from damaging the regulator circuitry by the conduction of Q6. Excessive current through the regulator circuitry results in an increase in current through the bridge rectifier and R12. This increase in negative voltage at the emitter of Q6 biases the transistor into conduction, which reduces the conduction of the series-pass transistor Q5. The regulator output is reduced by this action, limiting the output current to approximately 40 ma.

3-126. POWER SUPPLY B. The ac input voltage applied between terminals 9 and 10 is rectified by the bridge rectifier comprised of CR1 through CR4. The resulting positive and negative output voltages are then filtered

by C1 through C3 and A1C1 and A1C2 before being applied to the following +13.6 and ±15 volt dc regulator circuits.

3-127. The +15 volt dc regulator is comprised of Q2, Q3, Q6 through Q9, Q14 and CR5. The output voltage from this regulator is used as a reference for the other power supply regulator circuits while also providing operating voltages for the instrument. Transistors Q2 and Q3 are the series-pass elements whose conduction is controlled by the two stage comparison amplifier comprised of differentially connected transistors Q6, Q7, and Q8, Q9. The resistive network of R15 through R17 provides a sample of the regulator output voltage to the base of Q8. Resistor R16 provides adjustment of the regulator output voltage. A reference voltage from the zener CR5, upon which the instrument derives its measurement stability, is applied to the base of Q9. The first stage of the comparison amplifier then compares the sample of the regulator output voltage to the zener reference voltage and amplifies any resulting difference. Transistors Q6 and Q7 comprise the second stage of the comparison amplifier and amplify any resulting voltage difference detected by Q8 and Q9. The output of Q6 controls the conduction of the series-pass transistors Q2 and Q3, which in turn determines the output voltage of the regulator. Excessive current flow through the series-pass elements increases the voltage drop across R1 causing Q14 to increase its conduction. This increase in conduction of Q14 reduces the base current of the series-pass transistors, limiting the output current to approximately 200 ma.

3-128. The +13.6 volt dc regulator is comprised of Q1, Q4, Q5, and the externally mounted transistor Q2. The externally mounted transistor Q2 is the series-pass element whose conduction is controlled by the fixed bias established by the conduction of Q1, Q4, and Q5. This fixed bias voltage at the base of Q1 results in a stable +13.6 volt dc output over the output current range of the regulator. Excessive current through the series-pass element results in an increase in the voltage dropped across R2, which increases the conduction of Q1. This increases in conduction of Q1 reduces the base current of the series-pass element, limiting the output current to approximately 600 ma.

3-129. The -15 volt dc regulator is comprised of Q10, Q11, Q12, and Q13. Transistor Q13 is the series-pass element whose conduction is controlled by the comparison amplifier Q10 and Q11. Resistor R6 provides initial starting current to the regulator circuitry, and current limiting is provided by Q12. A resistive network comprised of R13 and R14 is connected across the +15 and -15 volt outputs. The base of Q11 is connected to the junction of R13 and R14 to provide a sample of the -15 volt dc output that is referenced to the +15 volt supply. The output of Q11 is inverted by Q10, and the resulting voltage used to control the conduction of the series-pass transistor Q13. Excessive current through the series-pass transistor will result in an increase in the voltage dropped across R7, which increases the conduction of Q12. This increase in conduction of Q12, reduces the base current of the series-pass transistor Q13, limiting the output current to approximately 250 ma.

SECTION IV

MAINTENANCE

4-1. INTRODUCTION

4-2. This manual section contains the information necessary for you to completely maintain your Model 9500A RMS Digital Voltmeter. The information is arranged under headings of "SERVICE INFORMATION, MAINTENANCE ACCESS, GENERAL MAINTENANCE, CALIBRATION PROCEDURES, TROUBLESHOOTING, and SELECTION OF FREQUENCY COMPENSATING COMPONENTS." A list of the test equipment required for maintenance of this instrument is contained in Figure 4-1. If the recommended test equipment is not available, other instruments having the equivalent specifications may be substituted.

4-3. Your instrument was completely tested and aligned before leaving the factory and calibration should not be necessary during the first 90 days of operation. However, should you wish to check the accuracy of the instrument against the specifications contained in Section I, the information contained in the Calibration Procedures (paragraphs 4-19 through 4-36) may be used. The Calibration Procedures are presented in such a manner that by disregarding the adjustment information they may be used as Instrument Performance Checks.

4-4. We recommend that you thoroughly read and understand this section of the manual before attempting any maintenance on your instrument.

EQUIPMENT	SPECIFICATIONS	RECOMMENDED INSTRUMENT
H. F. Oscillator	Frequency range from 10 Hz to 700 kHz, short term stability of ±50 ppm/min.	H. P. Model 651A
AC Amplifier	Frequency range from 10 Hz to 700 kHz. Gain stability of ±50ppm/min.	Krohn-Hite Model DCA 10
Thermal Transfer Standard	AC to DC transfer accuracy of ±0.01% at 10 Hz to 700 kHz from 1 to 100 volts rms.	Fluke Model 540B with test report.
DC Voltage Calibrator	Calibration accuracy of ±0.002% from 0.1 to 100 volts dc.	Fluke Model 332B
DC Differential Voltmeter	DC accuracy of ±0.01%.	Fluke Model 891A
Ratio Transformer	Accuracy of 1 ppm at 1 kHz.	Gertsch Model 1011
Oscilloscope	Calibrated sweep from 1 msec/cm to 500 usec/cm with a vertical sensitivity of 50 millivolts/cm.	Tektronix Model 545A with X1 probe.
Frequency Counter	Must be able to measure 2.5 kHz ±1 count with an accuracy of ±0.1%.	H. P. Model 5245L
Autotransformer	0 to 135 volts ac at up to 3 ampere.	G. R. Model W5MT
Voltage Divider	Minimum reactance at 700 kHz. Constructed of conformal coated metal film resistors.	453 ohm, ±1%, 1/2W 49.9 ohm, ±1%, 1/2W 56.2 ohm, ±1%, 1/2W
Function Generator	Squarewave output having a stability of 50 ppm/min. from 50 to 1000 Hz.	H. P. Model 3300A

Figure 4-1. REQUIRED TEST EQUIPMENT

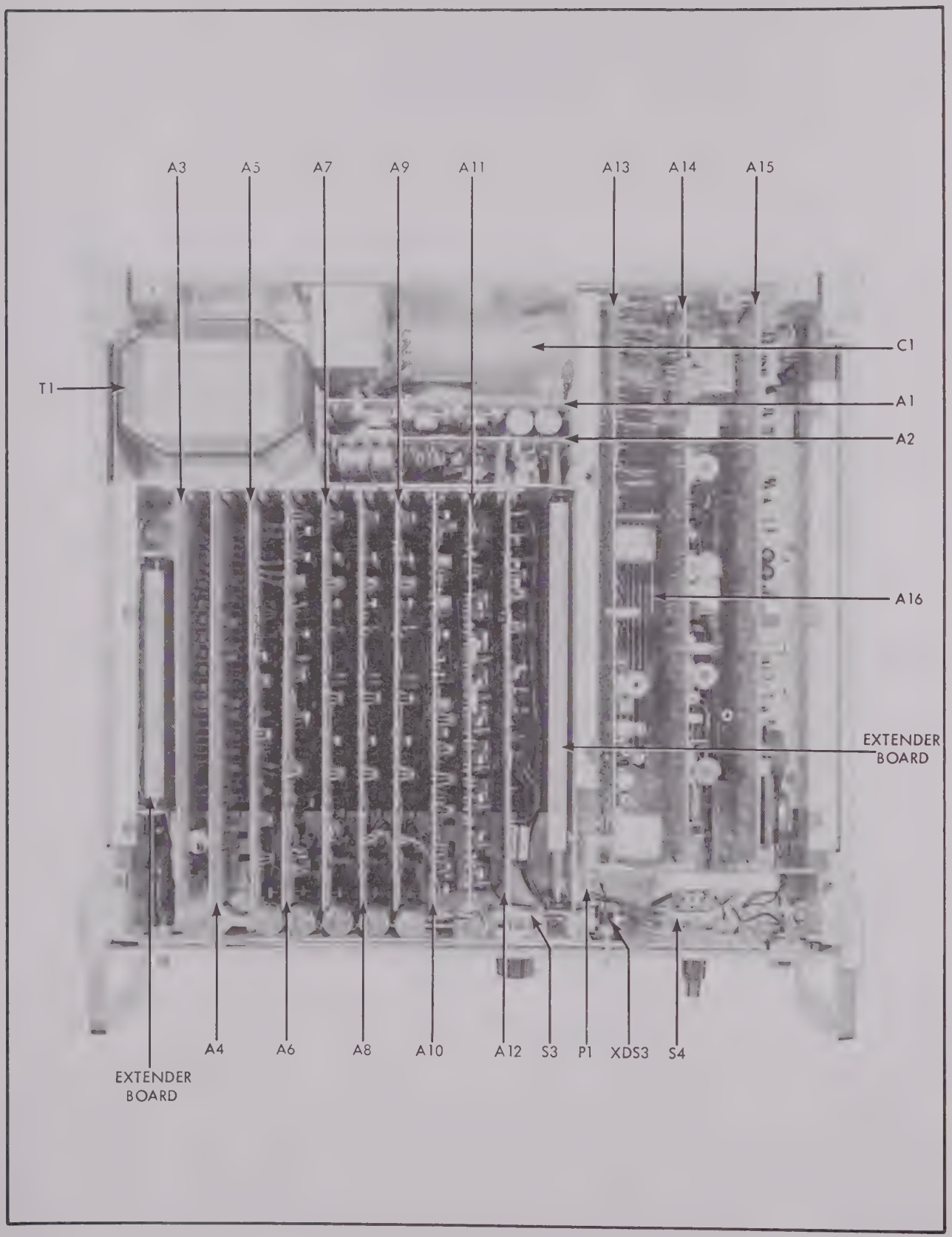


Figure 4-2. MAINTENANCE ACCESS COMPONENT LOCATIONS

4-5. SERVICE INFORMATION

4-6. Each instrument manufactured by the John Fluke Mfg. Co., Inc. is warranted for a period of one year upon delivery to the original purchaser. Complete warranty information is contained in the Warranty page located at the rear of this manual.

4-7. Factory authorized calibration and repair service for all Fluke instruments are available at various world wide locations. A complete list of factory authorized service centers is located at the rear of this manual. If requested, an estimate will be provided to the customer before any repair work is begun on instruments beyond the warranty period.

4-8. MAINTENANCE ACCESS

4-9. The following procedure is to be used to gain access to various portions of the Model 9500A.

a. Remove the top outer cover attaching screws and remove the cover from the instrument. This allows access to the major test points and adjustments.

b. Remove the bottom outer cover attaching screws and remove the cover from the instrument. This allows access to the bottom inner cover.

c. Remove the bottom inner cover attaching screws and remove the cover from the instrument. This allows access to the power transformer connections and the land-pattern side of the Mother Board assembly.

d. Remove the inner top cover attaching screws and remove the cover from the instrument. This allows access to all of the printed circuit board assemblies, maintenance extender boards, front panel switches and lamps, and the chassis mounted power supply filter capacitor. Location of these components are illustrated in Figure 4-2.

e. To gain access to the chassis mounted power supply transistors, remove the A1, A2, and A13 through A15 assemblies from the instrument. The transistors are vertically mounted below the power supply filter capacitor attaching points.

CAUTION!

When removing or replacing the printed circuit assemblies, a gentle rocking motion accompanied by an even pulling or pressing force should be used. Also, visually insure that the mating recepticals are correctly aligned when replacing the printed circuit assemblies.

4-10. GENERAL MAINTENANCE

4-11. PERIODIC CLEANING

4-12. If it becomes necessary to clean the exterior of the instrument, use a cloth moistened with anhyndrous ethyl alcohol or Freon T. F. Degreaser, MS180 Miller-Stephenson Chemical Co., Inc. If either of these cleaning agents are not readily available, soap and water applied sparingly to a cloth can be used to clean the exterior of the instrument.

4-13. The upper and lower covers of the Model 9500A are perforated to allow the entry and exit of cooling air thereby providing an entry for dirt, dust, and lint to the interior of the instrument. If it becomes necessary to clean the interior of the instrument, a hot water rinse using distilled or de-ionized water followed by a thorough drying should be used. Drying temperatures in excess of 160° F should be avoided.

CAUTION!

The use of solvents particularly keytones is not recommended because of the possible damage to the dielectric materials used in the instrument.

4-14. FUSE REPLACEMENT

4-15. The only fuse in the Model 9500A is located in a bayonet type fuse holder mounted on the rear of the instrument. The correct value of fuses are:

3/4 A, AGC, fast blowing, for 115-volt connection.

1/2 A, AGC, fast blowing, for 230-volt connection.

4-16. LAMP REPLACEMENT

4-17. The POWER ON lamp is located in the center of the PUSH ON-OFF POWER switch. To gain access to the lamp, unscrew the bezel around POWER switch and remove the push button. The lamp is pressed into the button from the rear. Pull the defective lamp out and press the replacement lamp into the button. Replace the button in the switch assembly and replace the bezel, screwing only finger tight.

4-18. The CALIBRATE and SAMPLE lamps are neon blinker lamps which should not require frequent replacement under normal circumstances. Should it become necessary, replacement may be accomplished by the following procedure:

a. Turn the instrument OFF and disconnect the power cord.

b. Remove the top outer and inner covers. Refer to paragraphs 4-8 through 4-9 for cover removal procedures.

c. Pull the connector, located behind the front panel, off the back of the defective lamp.

d. Inspection will reveal the lamp is held in the front panel by a black metal spring-clamp. With a pair of curved needle-nosed pliers, squeeze the ears of the clamp together and pull the lamp out from the front of the panel.

e. Install an identical replacement lamp in the socket and replace the connector removed in step c.

f. Apply ac power to the instrument and observe that the lamp will illuminate.

g. Remove power from the instrument and replace the top outer and inner covers.

4-19. CALIBRATION PROCEDURES

4-20. INTRODUCTION

4-21. The Model 9500A should be checked for calibration every 90 days or whenever repairs have been made to portions of the circuitry which will affect the calibration accuracy. In the event that the desired results of the calibration adjustments cannot be obtained, directions to the appropriate TROUBLESHOOTING or COMPENSATING paragraphs are given to enable rapid correction of the discrepancy.

4-22. Calibration of the instrument should be performed at an ambient room temperature of 71° F to 76° F (21.7° C to 24.4° C). Adjustment and test point locations are illustrated in Figure 4-3. At the beginning of each check the type of test equipment required for the check is given. Refer to Figure 4-1 for the recommended equipment.

4-23. CALIBRATION SIGNALS

4-24. Calibration of the Model 9500A requires a 0.1 to 100 volt rms signal at frequencies of 10 Hz to 700 kHz. An ac source such as the one illustrated in Figure 4-4 can be used to obtain calibrated 1.0 to 100 volt rms signals, accurate to within ±0.01%, at frequencies of 50 Hz to 700 kHz. A calibrated 0.1 volt rms signal at 500 Hz can be obtained using a ratio transformer with a one volt rms input. A calibrated 0.1 volt rms signal, accurate to within ±0.01%, at frequencies of 30 kHz, 50 kHz, 100 kHz, and 700 kHz can be obtained using the equipment connections and 10:1 divider illustrated in Figure 4-5 and performing the following steps:

a. Calibrate the Model 9500A using the procedures described in paragraph 4-31 steps a through t.

b. Make the equipment connections illustrated in Figure 4-5.

Note!

The 10:1 divider must be placed as close to the Model 9500A INPUT as possible or loading of the divider by the connecting cable will occur.

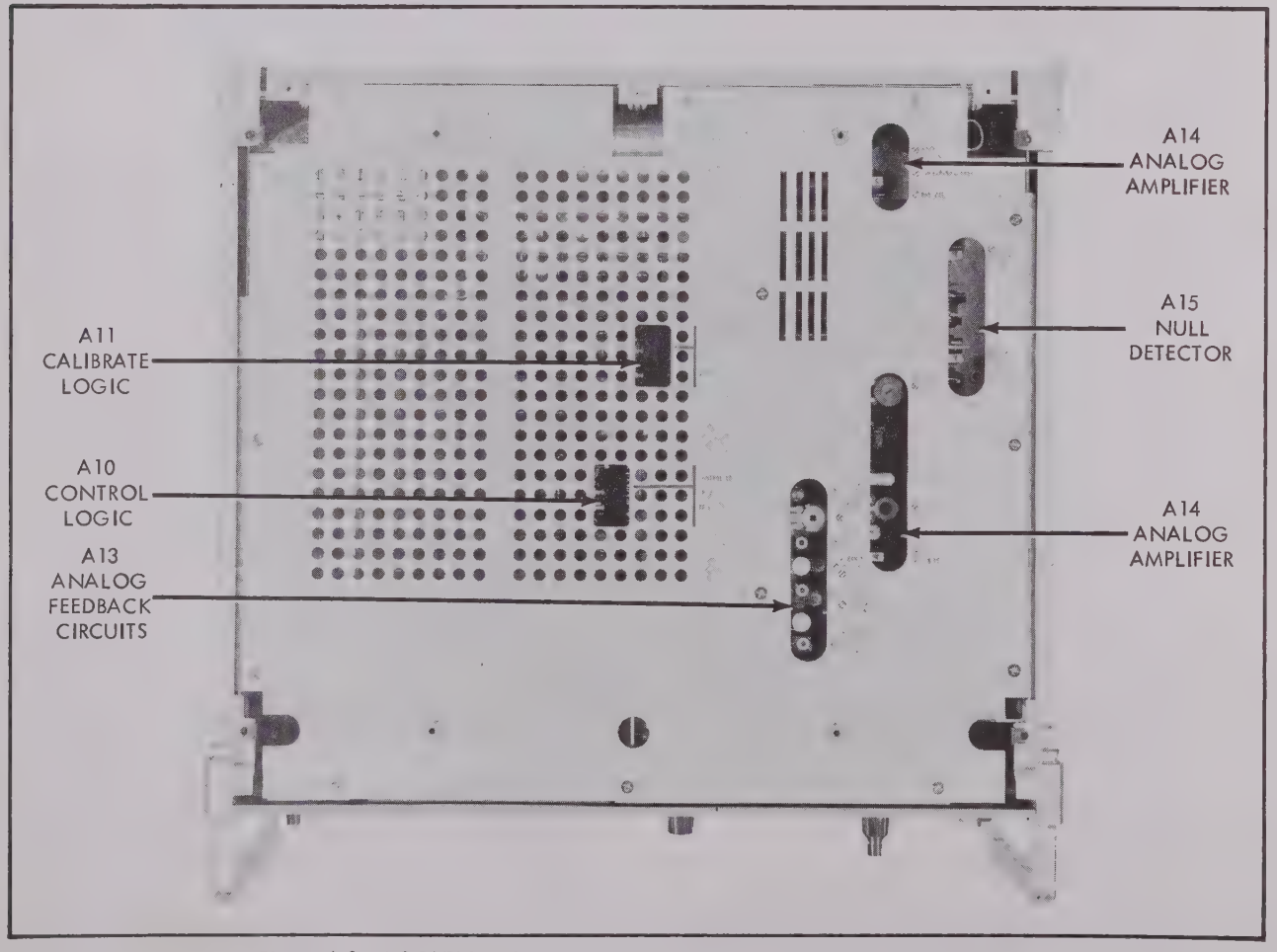


Figure 4-3. LOCATION OF CALIBRATION TEST POINTS AND ADJUSTMENTS

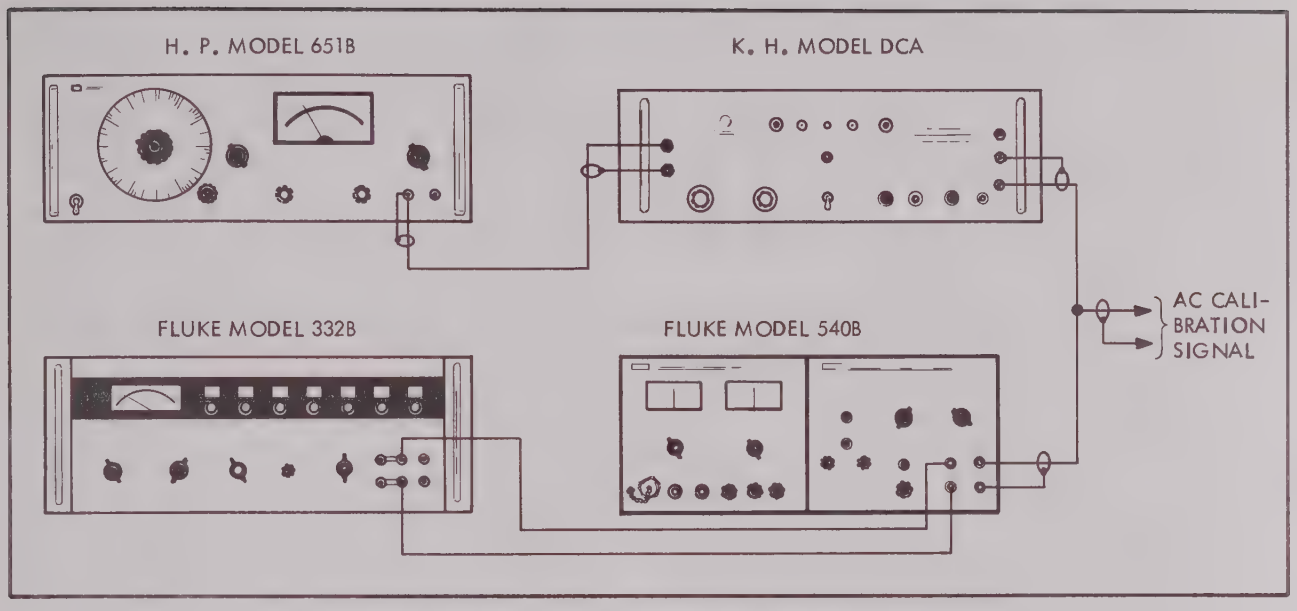


Figure 4-4. AC CALIBRATION SOURCE

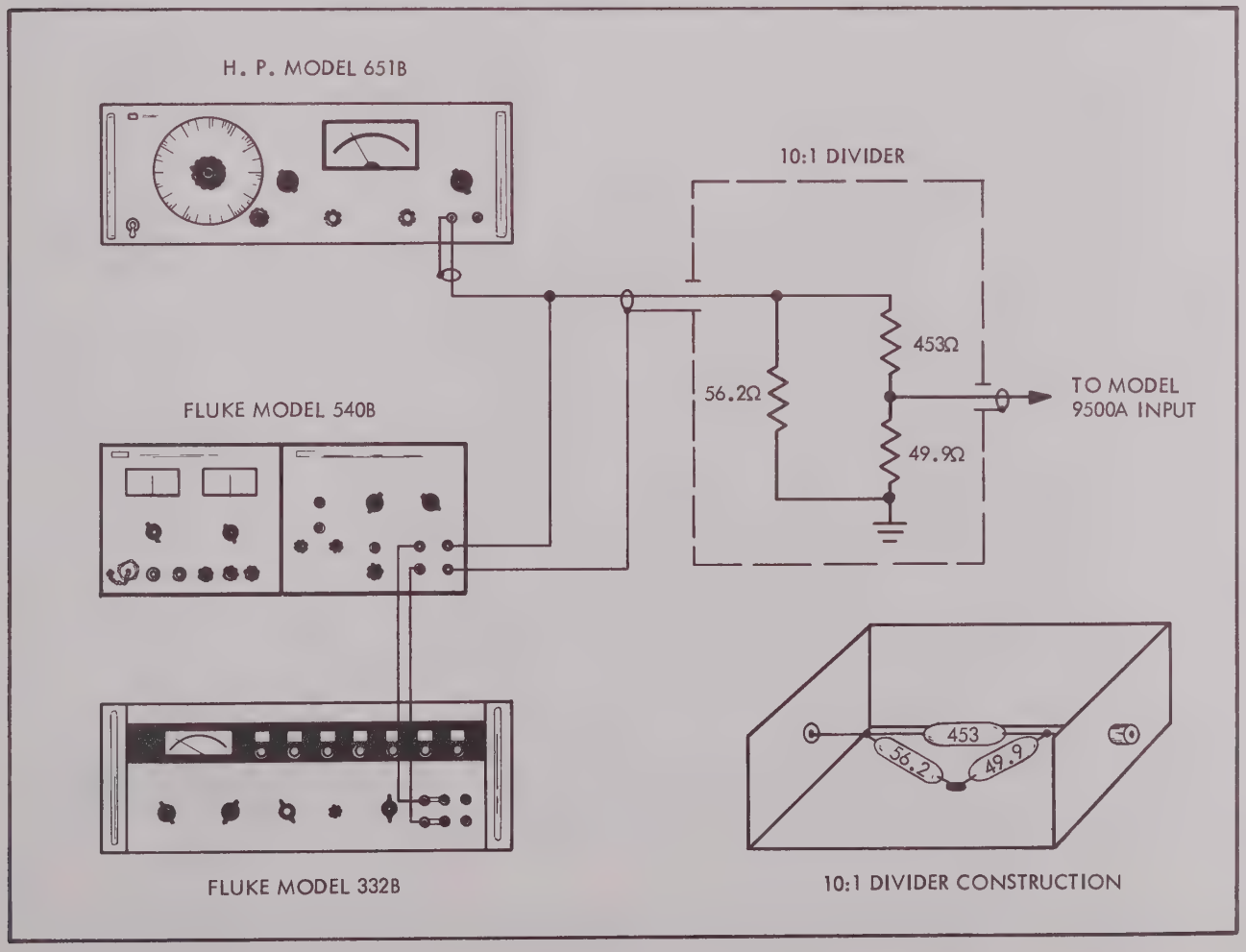


Figure 4-5. 30 KHZ TO 700 KHZ 0.1 VOLT RMS AC CALIBRATION SOURCE

c. Set the oscillator output frequency to 500 Hz and adjust its output level to obtain a reading of 0.1 volts rms on the Model 9500A.

d. Perform a thermal transfer, adjusting only the output of the dc power supply. The dc power supply output is now set to provide an ac-dc transfer that will produce the desired 0.1 volt rms signal at the output of the 10:1 divider.

4-25. POWER SUPPLY CHECKS

4-26. The Power Supply Checks require an autotransformer, an ac voltmeter, and a dc differential voltmeter. If the desired results of the following checks are not obtained, troubleshooting information is contained in paragraphs 4-43 through 4-45. To perform the checks, proceed as follows:

a. Remove the upper outer and inner covers from the instrument. Instructions for removing the covers are contained in paragraphs 4-8 and 4-9.

b. Make the equipment connections illustrated in Figure 4-6 and place the Model 9500A controls as follows:

RANGE	AUTO
DISPLAY TIME-SEC	2-10 AUTO CAL
INPUT	FLTG
VERNIER	Fully Clockwise

c. Apply 115 volts, 50 to 440 Hz, through the autotransformer to the Model 9500A.

d. Press the POWER switch, observing that the switch illuminates and allow the instrument to warm-up for one hour.

e. Connect the common lead of the dc differential voltmeter to A2TP2 and the input lead to A2TP4.

f. Adjust A2R16 for an indication of +15 volts dc ±10 millivolts.

g. Reduce the ac input voltage to 103.5 volts ac with the autotransformer control. The voltage observed on the dc voltmeter should not vary more than typically 15 millivolts.

h. Increase the ac input voltage to 126.5 volts ac with the autotransformer control. The voltage observed on the dc differential voltmeter should not vary more than typically 15 millivolts.

i. Return the ac input voltage to 115 volts ac with the autotransformer control.

j. Connect the dc differential voltmeter input to A2-TP3, observing that the voltmeter indicates -14.7 to -15.15 volts dc.

k. Repeat steps "g" through "i", observing that the voltage does not vary more than typically 20 millivolts.

l. Connect the dc differential voltmeter input to A2TP1 and observe the dc differential voltmeter indication. This voltage should be within 10 millivolts of the zener diode sticker voltage. The sticker is located on the land-pattern side of the A2 circuit board.

Note!

If the zener voltage is not contained on the zener diode sticker, it can be obtained upon request from the John Fluke Mfg. Co., Inc. Please include the serial number of your instrument and the existing information on the zener diode sticker when requesting this information.

m. Connect the dc differential voltmeter to A1TP4, observing that the voltmeter indicates +13.4 to +13.8 volts dc.

n. Repeat steps "g" through "i", observing that the voltage does not vary more than typically 20 millivolts.

o. Connect the dc differential voltmeter input to A1-TP3, observing that the voltmeter indicates +3.55 to +3.8 volts dc.

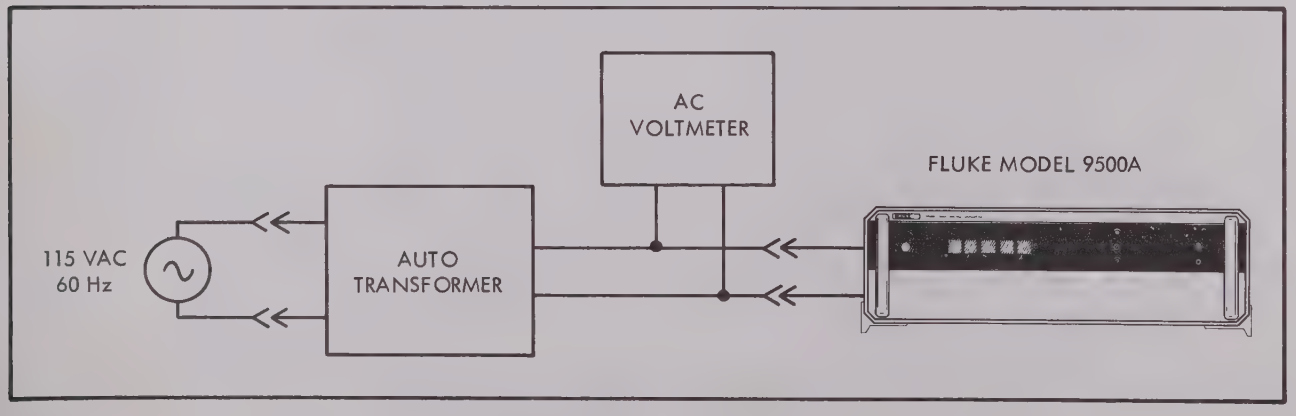


Figure 4-6. POWER SUPPLY CHECKS - EQUIPMENT CONNECTIONS

p. Repeat steps "g" through "i", observing that the voltage does not vary more than typically 60 millivolts.

q. Connect the dc differential voltmeter to A1TP1, observing that the voltmeter indicates +190 to +205 volts dc.

r. Repeat steps "g" through "i", observing that the voltage does not vary more than typically 5 volts.

s. Connect the dc differential voltmeter input to the top of A1R14, observing that the voltmeter indicates +100 to +115 volts dc.

4-27. When the results of these checks agree with the information given, the Power Supply A and B assemblies are functioning properly. The test equipment can now be disconnected from the instrument and the top inner cover replaced. The outer cover will remain off for the duration of the following checks.

4-28. AMPLIFIER BIAS CHECKS

4-29. The Amplifier Bias Checks require a calibrated ac source and a dc differential voltmeter. If the desired results of the following checks are not obtained, troubleshooting information is contained in paragraphs 4-46 through 4-52. To perform the checks, proceed as follows:

a. Place the Model 9500A controls to the following positions:

RANGE	10
DISPLAY TIME-SEC	2-10 AUTO CAL
INPUT	FLTG
VERNIER	Fully Clockwise

b. Apply a 10 volt rms 500 Hz signal, from a calibration source, to the input of the Model 9500A.

c. Connect the input of a dc differential voltmeter to A15TP4 and the common lead to the top of A15C11.

d. Adjust A15R39 for an indication of 0 ±0.5 millivolts on the dc voltmeter.

e. Connect the dc differential voltmeter input to A15TP6 and adjust A15R57 for an indication of +1.2 ±0.2 volts dc.

f. Connect the dc differential voltmeter common to the A14 AMPL GRD stud and the input to A14TP4. Adjust A14R22 to obtain an indication of 0 ±10 millivolts on the dc voltmeter.

g. Connect the dc differential voltmeter input to A14TP3 and adjust A14R44 for an indication of 0 ±10 millivolts on the dc voltmeter.

h. Repeat steps "e" and "g" until the desired results are obtained.

i. Connect the dc differential voltmeter input to A14TP2 and adjust A14R17 for an indication of 0 ±30 microvolts on the dc voltmeter.

4-30. When the results of these checks agree with the information given, the amplifier bias voltages are within tolerance and the calibration procedure can be continued.

4-31. RANGE CHECKS

4-32. The Range Checks require the use of a calibrated ac source, a ratio transformer, and a dc differential voltmeter. If the desired results of the following checks are not obtained, troubleshooting and compensating adjustments are contained in paragraphs 4-49 through 4-52 and 4-68 through 4-82, respectively. To perform the following checks, proceed as follows:

a. Apply a 10 volt rms 500 Hz signal, from a calibration source, to the input of the ratio transformer.

b. Set the ratio transformer output to 0.1 volts rms.

c. Place the Model 9500A RANGE switch to .1 and apply the ratio transformer output to the input of the Model 9500A.

d. Adjust the calibration source output level to obtain a readout of .10000 on the Model 9500A, and connect a shorting jumper between A10TP1 and TP2.

e. Connect the input of a dc differential voltmeter to A15TP4 and the common lead to the top of A15C11.

f. Adjust the calibration source output level slightly to obtain an indication of 0 ±0.3 millivolts at A15TP4.

g. Place the Model 9500A RANGE switch to 1 and set the ratio transformer output to 1.0 volts rms.

h. Adjust A13R159 for an indication of 0 ±0.3 millivolts at A15TP4.

i. Place the RANGE switch to 10 and set the ratio transformer output to 10 volts rms.

j. Adjust A13R162 for an indication of 0 ±0.3 millivolts at A15TP4.

k. Repeat steps a through k.

l. Apply a 100 volt rms 500 Hz signal, from a calibration source, to the input of the ratio transformer and set the ratio transformer output to 10 volts rms.

m. Adjust the calibration source output level for an indication of 0 ±0.3 millivolts at A15TP4.

n. Place the RANGE switch to 100 and set the ratio transformer output to 100 volts rms.

o. Adjust A13R165 for an indication of 0 ±0.3 millivolts at A15TP4.

p. Set the ratio transformer output to 10 volts rms and remove the shorting jumper from between A10TP1 and TP2.

q. Adjust the calibration source output level to obtain a readout of 010.00 on the Model 9500A and then

connect a shorting jumper between A10TP1 and TP2.

r. Adjust the calibration source output voltage to obtain an indication of 0± 0.3 millivolts at A15TP4.

s. Place the RANGE switch to 1000 and set the ratio transformer output to 100 volts rms.

t. Adjust A13R153 for an indication of 0 ±0.3 millivolts at A15TP4.

u. Apply the 50 kHz rms voltages on the ranges indicated in Figure 4-7 to the input of the Model 9500A and adjust the associated capacitor for an indication of 0 ±1.0 millivolt at A15TP4.

50 kHz INPUT VOLTAGE	MODEL 9500A RANGE	ADJUSTMENT TO OBTAIN 0±1.0 MILLIVOLT AT A15TP4
100	100	A13C10
10	10	A13C7
1	1	A13C4
.1	.1	A13C3

Figure 4-7. 50 KHZ RANGE ADJUSTMENTS

v. Perform the frequency response checks of Figure 4-8, observing that the voltage at A15TP4 is within the prescribed limited. Adjust A14R65 on the 10 volt range 50 Hz check for 0 ±0.5 millivolts at A15TP4.

w. Remove the jumper from between A10TP1 and TP2.

x. Place the Model 9500A RANGE switch to 100 and apply a 10 volt rms 500 Hz signal, from a calibration source, to the Model 9500A input.

y. Adjust the calibrated ac source for a readout of 010.00 on the Model 9500A and then connect a jumper between A10TP1 and TP2.

z. Apply a 10 volt rms 700 kHz signal to the Model 9500A input, observing that the voltage at A15TP4 is 0 ±1.0 millivolts.

4-33. When the results of these checks agree with the information given, the input ranges of the Model 9500A are correctly calibrated and the final self-calibration check can be performed.

4-34. FINAL SELF-CALIBRATION CHECKS

4-35. The Final Self-Calibration Checks require a calibrated ac source and a dc differential voltmeter. If the desired results of the following checks are not obtained, troubleshooting and compensating adjustment information is contained in paragraph 4-51 through 4-52. To perform the checks, proceed as follows:

a. Place the MODEL 9500A RANGE switch to 10 and connect a shorting jumper between A11TP1 and TP2.

b. Apply a 10 volt rms 500 Hz signal, from a calibration source, to the Model 9500A input and connect a shorting jumper between A10TP1 and TP2 when the readout stabilizes at 10.000.

c. Connect the input of the dc differential voltmeter to A15TP5 and the common lead to the top of A15C11.

d. Adjust A14R96 and A14R101 to obtain 0 ±50 millivolts at A15TP5.

e. Depress the Model 9500A CALIBRATE pushbutton and adjust A14R90 for 0 ±30 millivolts at A15TP5.

f. Remove the jumpers between the A10 and A11 testpoints.

g. Press the CALIBRATE pushbutton several times, observing that the Model 9500A indicates 10.000 with no greater deviation that ± one digit.

h. Remove the input rms voltage and allow the instrument to cycle through five or more auto-calibrate cycles, observing that the readout is 00.011± one digit.

i. Reapply the 10 volt rms 500 Hz signal to the Model 9500A input, observing that the Model 9500A indicates 10.000± one digit within three sample periods.

4-36. When the results of these checks agree with the information given, the Model 9500A is fully calibrated and the test equipment can be removed from the instrument.

MODEL 9500A RANGE	INPUT VOLTAGE	A15TP4 VOLTAGE LIMITS				
		50 Hz	10 Hz	30 kHz	100 kHz	700 kHz
100	100	0±2.1 mv	0±2.1 mv	0±5 mv	0±30 mv	.1 thru 10 volt ranges only. 0±0.4 mv
10	10					
1	1					
.1	.1					

Figure 4-8. RANGE FREQUENCY RESPONSE CHECKS

4-37. TROUBLESHOOTING

4-38. INTRODUCTION

4-39. Troubleshooting of the Model 9500A is somewhat more complex than the typical voltmeter because of the automatic control loops contained in the instrument circuitry. However, malfunctions can be categorized into three main areas of concern:

(1) Catastrophic where the instrument is completely inoperative.

(2) Analog where unstable or inaccurate measurements occur.

(3) Digital where the readout is locked to a high or low limit of a range or the instrument will not change ranges.

Catastrophic failures can usually be isolated to power supply problems if the instrument is completely inoperative. However, analog or digital failures are somewhat more difficult to localize and techniques for locating these troubles will be given the greatest attention.

4-40. Before any troubleshooting of the instrument is attempted, first insure:

a. The instrument is being properly operated and fails to meet its specifications.

b. The instrument does not require alignment as indicated by the Calibration Procedures.

c. A thorough inspection has been made for improperly seated printed circuit assemblies, loose wires, physically damaged components or other obvious problems.

4-41. Troubleshooting of the instrument first begins by isolating the trouble to a particular portion of the instrument circuitry such as the power supplies, analog section, or the digital section. An Operational Test is contained in Section II paragraphs 2-13 through 2-15. The results of this test, when compared with known circuit functions, can be used to determine which portion of the instrument circuitry that the trouble exists. A functional block diagram of the instrument, contained at the rear of this manual, will also aid in locating the trouble.

4-42. Once the trouble has been isolated to a particular portion of the instrument circuitry, input and output signals or voltages of the associated printed circuit assemblies can be measured to determine in which printed circuit assembly the trouble exists. The following procedures outline a parameter check of each printed circuit assembly contained in the instrument.

4-43. POWER SUPPLY CHECKS

4-44. The Power Supply Checks require an ac voltmeter, an autotransformer, a dc voltmeter, an oscilloscope, and the dummy load illustrated in Figure 4-9. To perform the checks, proceed as follows:

a. Remove the upper outer and inner covers from the instrument.

b. Remove the A3 through A15 assemblies from the instrument and mount the A2 Power Supply B assembly on the printed circuit board extender.

Note!

If the dummy load is not available, do not remove the A3 through A15 assemblies from the instrument.

c. Make the equipment connections illustrated in Figure 4-10 and connect the dummy loads illustrated in Figure 4-9 to the respective outputs of the power supplies.

d. Apply 115 volts ac through the autotransformer to the Model 9500A and press the POWER switch, observing that the switch illuminates.

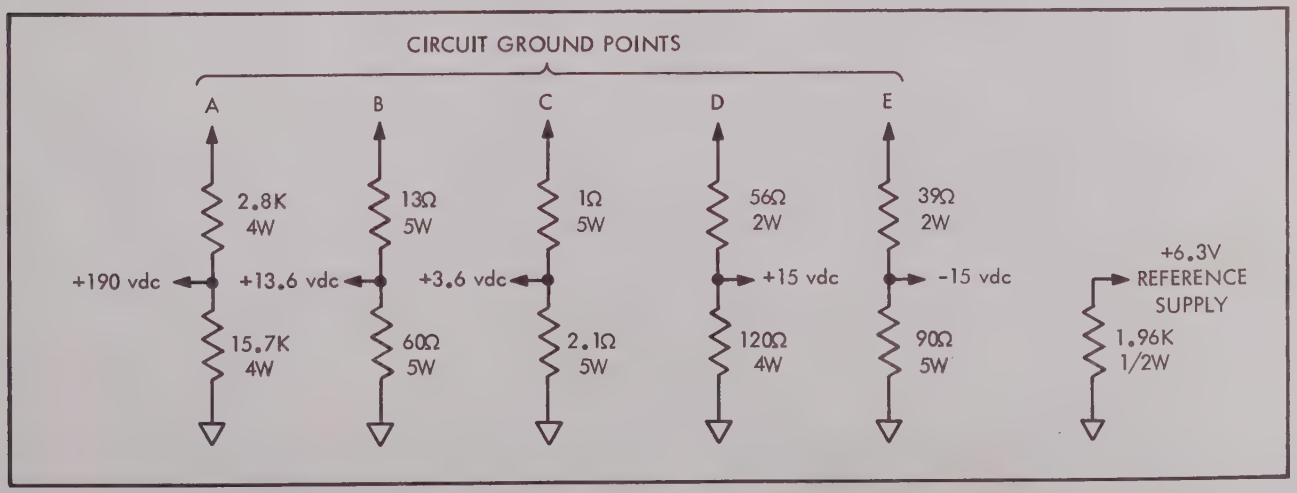


Figure 4-9. POWER SUPPLIES DUMMY LOADS

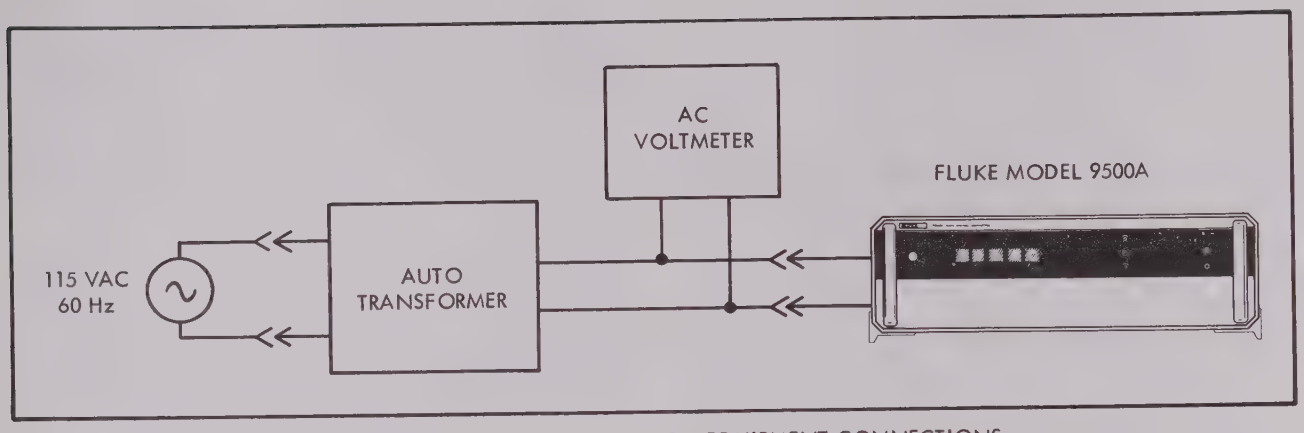


Figure 4-10. POWER SUPPLY CHECKS - EQUIPMENT CONNECTIONS

e. Connect the oscilloscope input to the + terminal of A2C2 and the ground lead to A2TP2. The signal observed on the oscilloscope CRT should not exceed a peak-to-peak amplitude of 1.2 volts.

f. Connect the oscilloscope input to A2 terminal 11 or 12, observing that the signal on the oscilloscope CRT does not exceed a peak-to-peak amplitude of 1.4 volts.

g. Connect the dc differential voltmeter input and common to A2TP4 and A2TP2, respectively. The dc differential voltmeter should indicate +15±0.01 volts dc.

h. Rotate A2R16 to each available limit, observing that the voltage at A2TP4 changes by at least ±0.8 volts dc.

i. Adjust A2R16 for +15±0.01 volts dc at A2TP4.

j. Connect the dc differential voltmeter input to A2TP1, observing that the voltage is 6.2 to 6.5 volts dc. This voltage must be within 10 millivolts of the voltage specified on the zener decal located on the land-pattern side of the A2 assembly.

k. Connect the dc differential voltmeter to A2TP3, observing that the voltage is -14.7 to -15.15 volts dc.

l. Remove ac line power from the Model 9500A and mount the A2 assembly in the instrument.

m. Mount the A1 assembly on the printed circuit board extender and energize the Model 9500A.

n. Connect the dc differential voltmeter and common to A1TP4 and A1TP2, respectfully. The dc differential voltmeter should indicate +13.4 to +14 volts dc.

o. Connect the oscilloscope signal input and ground to A1 terminals 13 or 14 and A1TP2, respectively. The signal observed on the oscilloscope CRT should not exceed a peak-to-peak amplitude of 1.3 volts.

p. Connect the oscilloscope signal input to the + terminal of A1C6. The signal observed on the oscilloscope CRT should not exceed a peak-to-peak amplitude of 30 volts.

q. Connect the dc differential voltmeter input to A1TP3, observing that the voltage is +3.55 to +3.75 volts dc.

r. Connect the dc differential voltmeter input to A1TP1, observing that the voltage is +190 to +205 volts dc.

s. Apply a ground to A1 terminal 9, observing that the voltage at A1TP1 decreases to between 80 and 120 volts dc.

t. Remove the ground from A1 terminal 9, observing that the voltage at A1TP1 returns to +190 to +205 volts dc.

u. Connect the oscilloscope signal input to the test points described in Figure 4-11, observing that the ripple does not exceed the specified peak-to-peak value.

v. Connect the dc differential voltmeter input to the test points indicated in Figure 4-12 and apply a ground for no longer than two seconds to the cor-

TEST POINT	DC VOLTAGE	TYPICAL PEAK-TO-PEAK RIPPLE
A1TP1	+190 Volts	2 Volts
A1TP4	+13.6 Volts	50 millivolts
A1TP3	+ 3.6 Volts	15 millivolts
A2TP4	+15 Volts	10 millivolts
A2TP3	-15 volts	12 millivolts

Figure 4-11. RIPPLE CHECKS

DC VOLTAGE TEST POINT	DUMMY LOAD GROUND POINT	OVERLOAD OUTPUT VOLTAGE
+190 A1TP1	A	80 to 110 volts dc
+ 13.6 A1TP4	B	7.5 to 8.5 volts dc
+ 3.6 A1TP3	C	2.4 to 2.95 volts dc
+ 15 A2TP3	D	7.1 to 8.7 volts dc
- 15 A2TP3	E	-6.3 to -7.8 volts dc

Figure 4-12. OVERLOAD CURRENT LIMIT CHECKS

responding points of the dummy load. The voltage observed at the test points should decrease to the specified overload value and then return to the normal output level.

4-45. When the results of these checks agree with the information given, the power supply assemblies are functioning normally. The test equipment can now be disconnected from the Model 9500A and the A3 through A15 assemblies inserted in the instrument.

4-46. ANALOG CIRCUITRY CHECKS

4-47. The following checks require a dc differential voltmeter with a 10K-ohm isolation probe, an oscilloscope, shorting jumpers, a square-wave generator, a frequency counter, a ratio transformer, and a calibrated ac source such as the one described in paragraph 4-23.

4-48. If components are replaced in either the A13 or A14 assemblies, it is conceivable that compensation of the associated circuitry may be required. Refer to paragraphs 4-68 through 4-82 for selection of compensating components.

4-49. A13 AND A14 ANALOG CIRCUITRY CHECKS. To perform the checks, remove the outer and inner covers from the instrument and proceed as follows:

a. Apply line power to the Model 9500A and place its controls as follows:

RANGE	.1
DISPLAY TIME-SEC	2-10 AUTO CAL
INPUT	FLTG
VERNIER	Fully Clockwise
POWER	Press to illuminate

b. Apply a 100 volt rms 500 Hz signal, from a calibration source, to the input of the ratio transformer.

c. Set the ratio transformer output to 0.1 volts rms.

d. Apply the 0.1 volt rms output of the ratio transformer to the Model 9500A INPUT. Adjust the calibration source output slightly to obtain a readout of .10000 on the Model 9500A and then connect a jumper between A10TP1 and TP2.

e. If the desired results are obtained, proceed to step i. If the desired results are not obtained, perform steps f through h to set the instrument circuitry to an equivalent .10000 readout.

f. De-energize the Model 9500A and remove the A5 through A10 assemblies from the instrument.

g. Apply grounds to terminals 4, 6, and 30 of the A13 assembly and energize the Model 9500A.

h. Repeat steps b and c.

i. Perform the bias voltage checks at the testpoints indicated in Figure 4-13 and, if necessary, adjust the appropriate adjustment to obtain the specified voltage. The final setting of these adjustments must not occur at any end limit of their adjustment range.

Note!

Steps j through n are performed only during the preceding bias checks.

j. Set the ratio transformer output to 0.01 volts rms.

k. Disconnect the jumper from A10TP1 and reconnect it when the Model 9500A indicates .01000. If the A5 through A10 assemblies have been removed from the instrument, remove the grounds from A13 terminals 4 and 6 and then ground A13 terminal 3.

TEST POINT	SPECIFIED VOLTAGE	ADJUSTMENT
A14TP1	-2±0.2 volts dc	A14R4
A14TP2	0±0.030 millivolts dc	refer to steps j thru n
A14TP3	0±0.010 volts dc	A14R44
A14TP4	0±0.010 volts dc	A14R22

Figure 4-13. BIAS CHECKS

l. Adjust A14R17 to obtain 0 ±30 microvolts at A14TP2.

m. Disconnect the jumper from A10TP1. If the A5 through A10 assemblies have been removed from the instrument, remove the ground from A13 terminal 3 and ground A13 terminals 4 and 6.

n. Set the ratio transformer output to 0.1 volts rms. When the Model 9500A indicates .10000, reconnect the jumper to A10TP1.

o. Observe the signals present at A14TP1 through A14TP4 with an oscilloscope. The peak-to-peak values should correspond to the waveforms contained in Figure 4-14.

p. Set the ratio transformer output to 0.01 volts rms and again observe the signals present a A14TP1 through A14TP4 with an oscilloscope. The peak-to-peak signal levels should be 1/10 of the values illustrated in Figure 4-14.

q. Perform the range checks described in Figure 4-15 at 500 Hz, observing that the signals at A14TP1 through A14TP4 correspond to the specified peak-to-peak levels of Figure 4-14. If the A5 through A10 assemblies have been removed from the Model 9500A, transfer the ground at A13 terminal 30 to the appropriate A13 and A14 terminals indicated in Figure 4-15.

r. Repeat the range checks of Figure 4-15 at frequencies of 50 Hz, 50 kHz, 100 kHz, and 700 kHz, observing that the signals at A14TP1 through A14-TP4 are consistant with the 500 Hz checks. Complete frequency response checks are contained in paragraph 4-31 of the Calibration Procedures. These checks should be performed only after the instrument is determined to be fully operational.

s. Place the RANGE switch to 1. If the A5 through A10 assemblies have been removed from the Model 9500A, transfer the grounds at A13 terminal 23 and A14 terminal 24 to A13 terminal 31 and A14 terminal 27, respectively.

t. Apply a one volt rms, 500 Hz, square-wave signal to the Model 9500A INPUT and monitor the signal present at A14TP4 with oscilloscope. There should be no clipping of any portion of the observed square-wave signal and the signal should not be distorted.

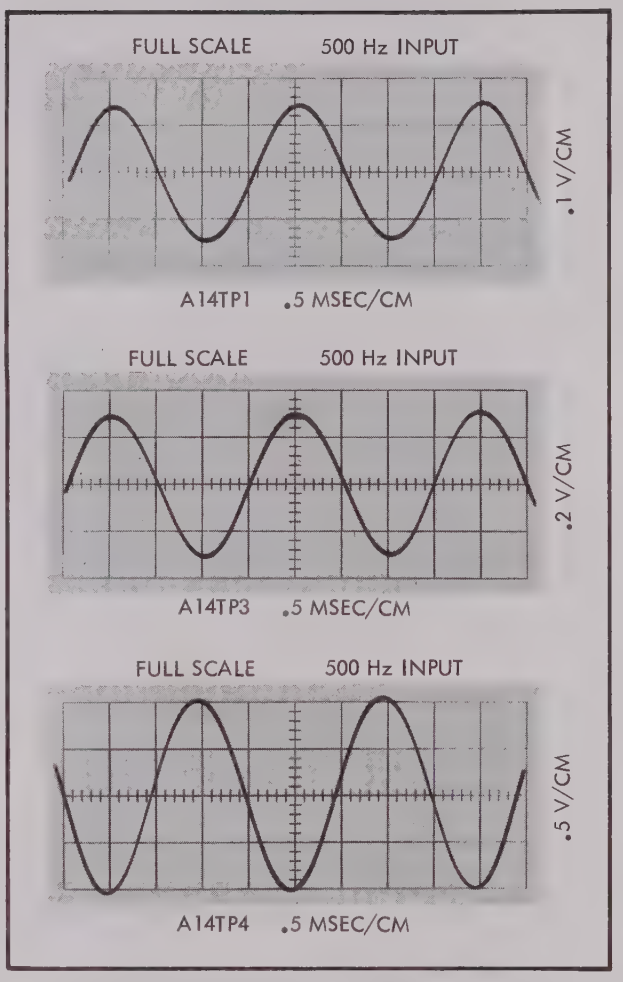


Figure 4-14. ANALOG AMPLIFIER WAVEFORMS

4-50. When the results of these checks agree with the information given the A13 and A14 assemblies are functioning normally and the following A15 assembly checks can now be performed.

RANGE SWITCH	MODEL 9500A INPUT RMS VOLTAGE	MODEL 9500A ASSEMBLY TERMINAL GROUNDS		PEAK-TO-PEAK WAVEFORM LEVEL OF FIGURE 4-13
		A13	A14	
1	.1	31	27	10%
	1			100%
10	1	32	24	10%
	10			100%
100	10	33	24	10%
	100			100%
1000	100	23	24	10%

Figure 4-15. RANGE CHECKS

4-51. A15 NULL DETECTOR CHECKS. To perform the following checks, proceed as follows:

a. Connect the input of the frequency counter to A15-TP1 and observe that the counter indicates 2.5 kHz ±10 Hz. If necessary, adjust the tuning slug of A15T1 to obtain the correct frequency.

b. Repeat paragraph 4-49 steps a through d. Steps e through g may also have to be performed.

c. Set the ratio transformer output to 0.12 volts rms.

d. Connect the input of an oscilloscope to A15TP2 and, if necessary, adjust the tuning slug of A15T2 to obtain the in-phase signal illustrated in Figure 4-16.

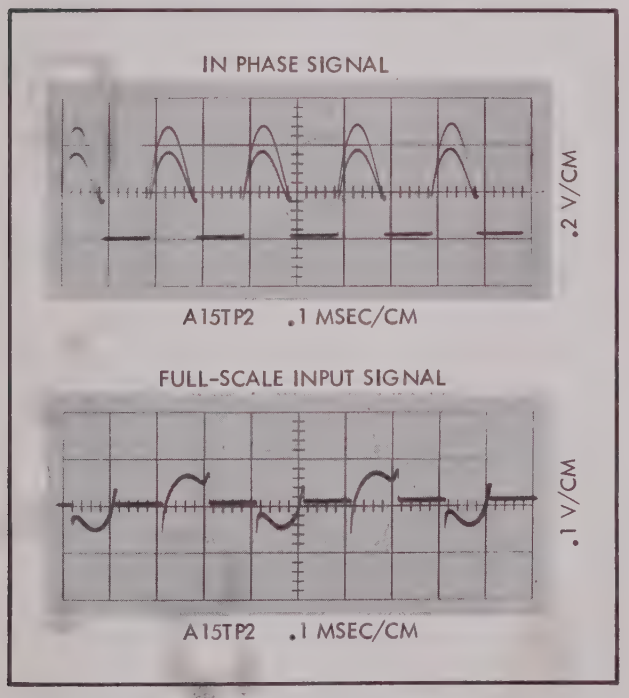


Figure 4-16. A15TP2 WAVEFORMS

e. Set the ratio transformer output to 0.1 volts rms.

f. Connect the input of an oscilloscope to A15TP3 (use dc coupling) and change the Model 9500A input rms voltage by 1% with the ratio transformer controls. The signal observed on the oscilloscope CRT should abruptly increase to a higher level with no overshoot. If necessary adjust A15R22 to obtain the desired signal.

g. Perform the voltage checks described in Figure 4-17 and, if necessary, adjust the appropriate adjustment to obtain the specified voltage. The final setting of these adjustments must not occur at an end-limit of their adjustment range. Ensure that the input rms voltage to the Model 9500A is 0.1 volts.

TEST POINT	TEST POINT	ADJUSTMENT
A15TP4	0 ±2 millivolts dc	A15R39
A15TP6	+1.2 ± 0.2 volts dc	A15T57

Figure 4-17. A15 BIAS CHECKS

h. Connect the dc differential voltmeter input to A15-TP5.

i. Slowly increase the input voltage to the Model 9500A with the ratio transformer controls, observing that the voltage at A15TP5 decreases to a maximum of -5.0 volts dc.

j. Return the ratio transformer controls to their initial settings and then slowly decrease the input voltage to the Model 9500A, observing that the voltage at A15TP5 increases to a maximum of +5.0 volts dc.

k. Set the ratio transformer output to 0.1 volts rms.

l. Connect the dc differential voltmeter input to A15-TP6 and repeat step i. The voltage at A15TP6 should decrease from +1.2 volts dc to -4 volts dc.

m. Repeat step j, observing that the voltage at A15TP6 decreases to a maximum of -5 volts dc.

n. Repeat step k.

o. Connect the oscilloscope input to the A15 green jumper wire, observing that the signal on the oscilloscope CRT has a period of approximately 70 milliseconds.

p. Increase the rms input voltage to the Model 9500A until there is -4.0 volts at A15TP6, observing that the signal on the oscilloscope CRT has a period of approximately 30 microseconds.

q. Remove the rms voltage applied to the INPUT of the Model 9500A and disconnect all ground jumpers from the instrument.

r. Ground the A15 terminals, one at a time as indicated in Figure 4-18, observing that the specified dc voltage is present at the associated circuit checkpoint.

s. Connect the oscilloscope input to A15 terminal 12. The 5 kHz signal observed on the oscilloscope CRT should have a peak-to-peak amplitude of 0.01 to 0.02 volts.

t. Apply a ground to A15 terminal 13, observing that the 5 kHz signal is no longer present on the oscilloscope CRT.

u. Apply a 0.1 volt rms, 500 Hz, signal to the INPUT of the Model 9500A and then reconnect the ground

GROUNDED A15 TERMINAL	CIRCUIT CHECKPOINT	OBSERVED DC VOLTAGE
1 2 3 4	Junction A15R71 and A15R72	-3 volts dc
5 6	A15TP4	-1 volt dc
7 8	A15TP4	-4 volts dc
5 6 7 8 13 14	A15 Terminal 19	-1 volt dc
15	A15TP4	zero volts dc

Figure 4-18. CONTROL LOOP GAIN CHECKS

jumpers removed in step q to obtain a .10000 readout. Also connect the input of a dc differential voltmeter to A15 terminal 18, observing that the voltage at A15 terminal 18 is +13 volts dc.

v. Slowly increase the rms input voltage to the Model 9500A, observing that the voltage at A15 terminal 18 abruptly decreases to less than +5 volts dc when the rms voltage is approximately 0.11999 volts rms.

Note!

The following checks are to be performed only if the A11 Calibration Logic assembly is known to be functioning properly. Test procedures for the A11 Calibration Logic assembly are contained in paragraph 4-59.

w. Apply a 0.1 volt rms 500 Hz signal, from a calibration source, to the INPUT of the Model 9500A and connect the input of a dc differential voltmeter to A15TP4.

x. Connect a jumper between A11TP1 and A11TP2 and adjust A14R96 and A14R101 for 0 ±1 millivolts at A15TP4. If the desired results are obtained, proceed to step ab. If the desired results are not obtained, perform steps y through aa.

y. Rotate A14R96 fully clockwise and reconnect any EXPAND ADJ jumpers that have been cut on the A14 assembly.

z. With the information provided in Figure 4-19, observe the voltage at A15TP4 and cut the appropriate jumper or jumpers.

A15TP4 DC VOLTAGE	EXPAND ADJUST JUMPER TO BE CUT
+0.1 volt	NONE
+0.1 to -0.3 volts	#1
-0.3 to -0.6 volts	#2
-0.06 to -0.9 volts	#1 and #2
-0.9 to -2.1 volts	#4
+2.1 volts	#4 and repeat step z.

Figure 4-19. EXPAND ADJUST JUMPER SELECTION

aa. Adjust A14R96 and A14R101 for 0 ±2 millivolts at A15TP4.

ab. Press the CALIBRATE pushbutton and adjust A14-R90 for 0 ±1 millivolt at A15TP4. If the results of this step are not obtained, proceed with steps ac through ae.

ac. Rotate A14R90 fully counter-clockwise and reconnect any Cal. Adj. jumpers that have been cut on the A14 assembly.

ad. Depress the CALIBRATE pushbutton and, using the information provided in Figure 4-20, cut the appropriate jumper or jumpers.

A15TP4 DC VOLTAGE	CAL ADJ. JUMPER TO BE CUT
-100 to -30 millivolts	NONE
- 30 to +35 millivolts	#2
+ 35 to +100 millivolts	#4
+100 to +160 millivolts	#2 and #4
+160 to +500 millivolts	#8 and repeat step ab.

Figure 4-20. CALIBRATE ADJUST JUMPER SELECTION

ae. Press the CALIBRATE pushbutton and adjust A14-R90 for 0 ±1 millivolt at A15TP4.

4-52. When the results of these checks agree with the information given, the analog circuitry in the Model 9500A is functioning properly and the test equipment can be disconnected from the instrument.

4-53. DIGITAL CIRCUITRY CHECKS

4-54. The following tests require a dc differential voltmeter, an oscilloscope, shorting jumpers, a ratio transformer, and a calibrated ac source such as the one described in paragraph 4-23.

4-55. A12 SAMPLE CIRCUIT CHECKS. To perform the following checks, mount the A12 assembly on the extender board, and proceed as follows:

a. Place the Model 9500A controls as follows:

RANGE	.1
DISPLAY TIME-SEC	.1-2 MAN CAL
VERNIER	Fully CCW
INPUT	FLTG
POWER	Press to energize instrument

b. Connect the oscilloscope signal input and ground to A12 terminal 19 and 26, respectively.

c. The sample pulse present on the oscilloscope CRT shall have a peak-to-peak amplitude of 1 to 3 volts with a dc reference of 0 to +0.3 volts dc. Pulsewidth of the waveform shall be from 3.1 to 6.3 milliseconds.

d. Place the DISPLAY TIME-SEC and VERNIER controls to the positions indicated in Figure 4-21, observing that the time between sample pulses in the oscilloscope CRT is within the specified tolerance.

DISPLAY TIME-SEC	VERNIER	REPETITION RATE
.1 - 2	Fully CCW	90 to 115 milliseconds
.1 - 2	Fully CW	1.8 to 2.3 seconds
2 - 10	Fully CCW	1.8 to 2.3 seconds
2 - 10	Fully CW	9 to 11.5 seconds

Figure 4-21. SAMPLE PULSE REPETITION RATES

e. Observe that the SAMPLE lamp illuminates each time the sample pulse is present on the oscilloscope CRT.

f. Place the DISPLAY TIME-SEC control to the 2-10 AUTO CAL position and connect the oscilloscope input to A12 terminal 7.

g. A negative calibrate-start pulse shall appear on the oscilloscope CRT after every other illumination of the SAMPLE lamp. The calibrate-start pulse waveform is illustrated in Figure 4-22.

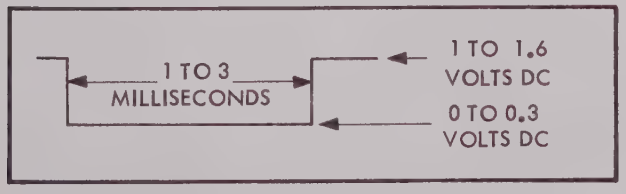


Figure 4-22. CALIBRATE START PULSE

h. If the A11 Calibration Logic assembly is installed in the Model 9500A, press the MANUAL CALIB switch and measure the voltage at A12 terminal 13 with a dc voltmeter. The voltage should be approximately 3 volts dc. If the A11 assembly has been removed from the instrument, connect a jumper wire between A12 terminal 13 and 25. Intermittantly touch a ground jumper to either terminal 21 or 22, with 3 volts at terminal 13, observing that the CALIBRATE lamp blinks.

i. Disconnect the jumpers from the A12 assembly.

j. Connect the dc differential voltmeter input to A12 terminal 2, observing that the voltmeter indicates 0.9 to 1.4 volts dc.

k. Connect a jumper between A12 terminal 1 and 25, observing that the voltmeter indication decreases to between 0 and +0.3 volts dc.

l. Transfer the jumper connection from A12 terminal 1 to A12 terminal 4, observing that the SAMPLE lamp remains extinguished.

m. Connect another jumper to A12 terminal 25 and momentarily touch the other end of the jumper to A12 terminal 3. The SAMPLE lamp should illuminate each time the jumper touches A12 terminal 3.

4-56. When the results of these checks agree with the information given, the A12 assembly is functioning properly. The test equipment can now be disconnected and the assembly installed in the Model 9500A.

4-57. A10 CONTROL LOGIC CHECKS. To perform the following checks, mount the A10 assembly on the extender board and proceed as follows:

a. Place the Model 9500A controls as follows:

RANGE	.1
DISPLAY TIME-SEC	.1-2 MAN CAL
VERNIER	Fully CCW
INPUT	FLTG
POWER	Press to energize Model 9500A

b. Connect the oscilloscope input and ground to A10 terminal 17 and 26, respectively. The clock signal appearing on the oscilloscope CRT shall have a peak-to-peak amplitude of 1.5 to 3 volts and have a dc reference of 0 to +0.3 volts dc.

c. Apply 100 volts rms at 500 Hz to the input of the ratio transformer and set the ratio transformer output to 0.1 volts rms.

d. Apply the output of the ratio transformer to the Model 9500A INPUT and adjust the calibration source to obtain a readout of .10000 on the Model 9500A. When the .10000 readout is obtained, connect a jumper between A10TP1 and TP2 and proceed to step h. If the desired readout cannot be obtained, perform steps e through g.

e. De-energize the Model 9500A and remove the A5 through A9 assemblies from the instrument.

f. Connect ground jumpers to A13 terminals 4, 6, and 30 and energize the Model 9500A.

g. Apply the 0.1 volt rms output of the ratio transformer to the Model 9500A INPUT.

h. Connect the dc differential voltmeter input and common to A10 terminal 8 and 26, respectively.

i. Adjust the ac calibration source for -0.07 volts dc at A10 terminal 8.

j. Perform the voltage measurements at the A10 terminals indicated in Figure 4-23, observing that the dc voltage is within the specified tolerance.

A10 TERMINAL	DC VOLTAGE
19	+1.0 to +3 volts dc
20	0 to +0.3 volts dc
21	+0.19 to +0.3 volts dc
22	-1.0 to -2 volts dc

Figure 4-23. UP GATE VOLTAGES

k. Adjust the ac calibration source for +0.07 volts dc at A10 terminal 8.

l. Perform the voltage measurements at the A10 terminals indicated in Figure 4-24, observing that the dc voltage is within the specified tolerance.

A10 TERMINAL	DC VOLTAGE
19	0 to +0.3 volts dc
20	+1 to +3 volts dc
21	-1 to -2 volts dc
22	+0.19 to 0.3 volts dc

Figure 4-24. DOWN GATE VOLTAGES

m. Connect the oscilloscope input to A10 terminal 4 and disconnect the jumper from A10TP1.

n. Slowly increase the rms input voltage applied to the Model 9500A, observing that the waveform illustrated in Figure 4-25 appears on the oscilloscope CRT.

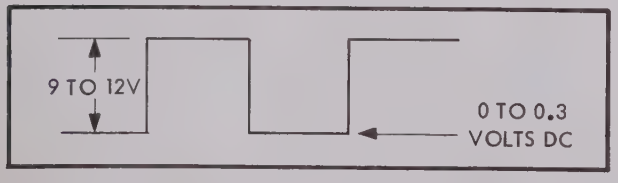


Figure 4-25. PRECOUNTER OUTPUT

o. Slowly decrease the rms input voltage applied to the Model 9500A, observing that the waveform illustrated in Figure 4-25 again appears on the oscilloscope CRT.

p. Return the rms input voltage applied to the Model 9500A to its original 0.1 volt rms value.

q. Connect the oscilloscope input to A10 terminal 5 and repeat steps n through p.

r. Connect the oscilloscope input to A10 terminal 6 and repeat steps n through p.

s. Connect the oscilloscope signal and trigger inputs to A10 terminal 18 and adjust the oscilloscope controls for a stable 3.1 to 6.3 millisecond sample pulse.

t. Connect the oscilloscope input to A10 terminal 16 and then increase the rms input voltage applied to the Model 9500A by 1%. The waveform illustrated in Figure 4-26 should appear on the oscilloscope CRT.

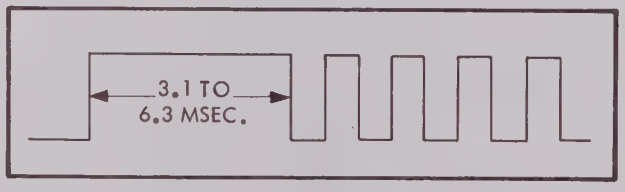


Figure 4-26. PRE-CARRY PULSE DURING SAMPLE TIME

u. Repeat step p.

v. Connect a dc coupled oscilloscope input to A10 terminal 2 and vary the rms input voltage about its 0.1 volt level by 1%. The voltage at terminal 2 shall be low (0 to 0.3 volts dc) for approximately 1.6 seconds and then switch to a high (1.5 to 3.0 volts dc).

w. If the A5 assembly has not been previously removed from the instrument, de-energized the Model 9500A and removed the A5 assembly.

x. Connect a ground jumper to the Mother Board A5 terminal 2 and energize the Model 9500A.

y. Repeat step p and connect the jumper between A10-TP1 and A10TP2.

z. Connect the dc differential voltmeter input to A10 terminal 10, observing that the voltage is 0 to +0.3 volts dc.

aa. Decrease the rms input voltage applied to the Model 9500A by 1% and connect a ground jumper to A10 terminal 15. The voltage at A10 terminal 10 should increase to between 1 to 3 volts dc.

ab. Increase the rms input voltage applied to the Model 9500A by 2%, observing that the voltage at A10 terminal 10 decreases to between 0 to +0.3 volts dc.

ac. Connect the dc differential voltmeter input to A10 terminal 11, observing that the voltage is 0 to 0.3 volts dc.

RESISTOR OR RESISTORS TO REMOVE		MEASURED TIME INTERVAL STEP F
Dual Inline	u Logic	
None	None	20 to 25 seconds
R17	R66	17.6 to 21 seconds
R18	R67	16.5 to 19 seconds
R19	R68	14 to 17 seconds
R17 & R18	R66 & R67	13.5 to 16 seconds
R20	R35	12.7 to 15 seconds
R17 & R19	R66 & R68	11.5 to 13.5 seconds
R18 & R19	R67 & R68	10 to 12 seconds
R17 & R20	R35 & R67	9 to 10.5 seconds

Figure 4-27. START-UP TIME RESISTOR SELECTION

ad. Connect ground jumpers to A10 terminals 12, 13, and 14 (terminal 15 was grounded in step aa). The voltage at A10 terminal 11 should increase to between 1 and 3 volts dc.

4-58. When the results of these checks agree with the information given, the A10 assembly is functioning properly. The test equipment can now be disconnected and the assembly installed in the Model 9500A.

4-59. A11 CALIBRATE LOGIC CHECKS. To perform the following checks, mount the A11 assembly on the extender board, and proceed as follows:

a. Place the Model 9500A controls as follows:

RANGE	.1
DISPLAY TIME-SEC	.1-2 MAN CAL
VERNIER	Fully CCW
INPUT	FLTG

b. Connect the dc differential voltmeter input and common to A11 terminals 13 and 21, respectively.

c. Press the Model 9500A POWER switch and observe that the voltmeter indicates 0 to +0.3 volts dc for 20 to 25 seconds. After this interval the voltmeter should indicate 1 to 1.5 volts dc.

d. If an abnormal time interval is observed in step c, de-energize the Model 9500A and perform steps e through h.

e. Install all the resistors listed in Figure 4-27 that correspond to your particular A11 assembly.

f. Energize the Model 9500A and again observe the 0 to +0.3 volt time interval on the dc voltmeter.

g. Use the measured time interval of step f to remove the resistor or resistors listed in Figure 4-27.

h. De-energize and then energize the Model 9500A, observing that the time interval indicated by the dc voltmeter is 20 to 25 seconds.

i. De-energize the Model 9500A and connect the oscilloscope input and ground to A11A3 terminal 2 (TP4 on dual inline assemblies) and A11 terminal 21, respectively.

j. Energize the Model 9500A, observing that a 50 millisecond square-wave signal appears on the oscilloscope CRT only during the first 20 to 25 seconds of instrument operation.

k. Place the DISPLAY TIME-SEC switch to the 2-10 AUTO CAL position.

l. Connect the oscilloscope input to A11 terminal 13, observing that the waveform illustrated in Figure 4-28 appears on the oscilloscope CRT.

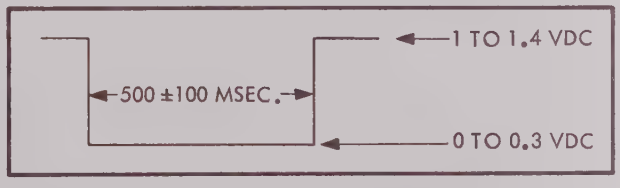


Figure 4-28. AUTOMATIC CALIBRATE COMMAND WAVEFORM

m. Connect the oscilloscope input to the A11 terminals indicated in Figure 4-29, observing that the specified waveform is present on the oscilloscope CRT.

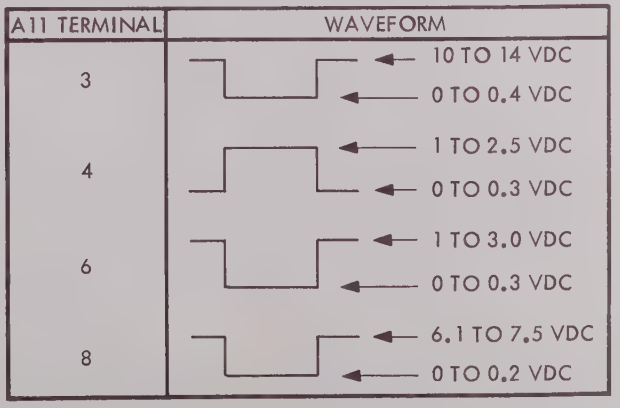


Figure 4-29. CALIBRATE LOGIC COMMANDS

A5 TERMINAL	RANGE					DC VOLTAGE	
	.1	1	10	100	1000	HIGH	LOW
2	L	H	H	H	H	13.4-14	.5-1.5
3	H	L	H	H	H	13.4-14	.5-1.5
4	H	H	L	H	H	13.4-14	.5-1.5
5	H	H	L	L	L	10-12	.5-2.2
6	H	H	H	L	L	13.4-14	.5-1.5
7	H	H	H	H	L	10-13	0-0.5

Figure 4-30. MANUAL RANGE CHECKS

n. Observe that the CALIBRATE lamp blinks in sequence with every other illumination of the SAMPLE lamp.

o. Depress the CALIBRATE pushbutton, observing that the CALIBRATE lamp blinks.

4-60. When the results of these checks agree with the information given, the A11 assembly is functioning properly. The test equipment can now be disconnected and the assembly installed in the Model 9500A.

4-61. A5 RANGE LOGIC CHECKS. To perform the following checks, mount the A5 assembly on the extender board and proceed as follows:

a. Place the Model 9500A controls as follows:

RANGE	.1
DISPLAY TIME-SEC	.1-2 MAN CAL
VERNIER	Fully CCW
INPUT	FLTG
POWER	Press to energize instrument

b. Connect the dc differential voltmeter common lead to A5 terminal 31.

c. Perform the manual range terminal voltage checks indicated in Figure 4-30, observing that the measured voltage is within the specified value.

d. Place the RANGE switch to AUTO and connect a ground jumper to the base of A5Q2 (A5TP1 on dual inline assemblies). The decimal point in the A5 indicator tube should be illuminated.

e. Connect the oscilloscope input to A5TP1 (A5TP2 on dual inline assemblies) and connect its ground to A5 terminal 31.

f. Observe that the sawtooth waveform illustrated in Figure 4-31 appears on the oscilloscope CRT. If the waveform duration is out of tolerance, perform steps g through h.

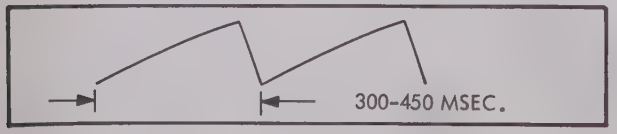


Figure 4-31. RANGE OSCILLATOR WAVEFORM

g. De-energize the Model 9500A and install all of the A5 resistors listed in Figure 4-32 on the A5 assembly.

h. Energize the Model 9500A and, observing the range oscillator waveform duration, use the information provided in Figure 4-32 to select the necessary resistance value.

RANGE OSCILLATOR WAVEFORM DURATION	RESISTOR OR RESISTORS TO BE REMOVED
300 to 450 msec	NONE
250 to 300 msec	R3
230 to 300 msec	R4
172 to 240 msec	R3 & R4
150 to 200 msec	R2

Figure 4-32. RANGE OSCILLATOR RESISTOR SELECTION

i. Place the RANGE switch to 1000, observing that the range oscillator waveform disappears from the oscilloscope CRT.

j. Place the RANGE switch to AUTO and remove the ground jumper from the base of A5Q2 or A5TP1.

k. Apply a 100 volts rms 500 Hz signal to the input of the ratio transformer and set the ratio transformer output to 0.1 volts rms.

l. If the A6 through A9 assemblies have been removed from the instrument, apply grounds to A13 terminals 4 and 6.

m. Apply the rms input voltages indicated in Figure 4-33 to the Model 9500A INPUT, observing that the specified dc voltage is present at the corresponding A5 terminals.

n. Place the RANGE switch to 1000 and apply 100 volts rms to the Model 9500A INPUT.

o. When the Model 9500A readout is 0100.0 connect a jumper between A10TP1 and A10TP2. If the A6 through 9 assemblies have been removed from the instrument, remove the grounds from A13 terminals 4 and 6 and then ground A13 terminal 3.

A5 TERMINALS	MODEL 9500A RMS INPUT VOLTAGE				DC VOLTAGE	
	.1	1	10	100	HIGH (H)	LOW (L)
2	L	H	H	H	13.4 to 14v	0.5 to 2.2v
3	H	L	H	H		
4	H	H	L	H		
5	H	H	L	L		
6	H	H	H	L		
14	H	L	H	L	3.6±0.3v	0 to 0.4v
15	H	H	L	L		
16	H	H	H	H		

Figure 4-33. 0.1 TO 100 AUTO RANGE CHECKS

p. Place the RANGE switch to AUTO observing that the A5 terminal voltages of Figure 4-34 are at their specified values.

A5 TERMINALS	TERMINAL STATE	DC VOLTAGE	
		HIGH	LOW
2	H	13.4 to 14v	0.1 to 2.2v
3	H		
4	H		
5	L		
6	L		
7	L		
14	H	3.6±0.3v	0 to 0.4v
15	H		
16	L		

Figure 4-34. 1000 AUTO RANGE CHECK

q. Connect a ground jumper to A5 terminal 23, observing that a numeral 1 is illuminated in the A5 indicator tube.

4-62. When the results of these check agree with the information given, the A5 assembly is functioning properly. The test equipment can now be disconnected and the assembly installed in the instrument.

4-63. A7, A8, AND A9 0-TO-9 COUNTER CHECKS. To perform the following checks, mount the A9 assembly on the extender board and proceed as follows:

Note!

The A6 through A8 assemblies must be installed.

a. Place the Model 9500A controls as follows:

RANGE	1000
DISPLAY TIME-SEC	.1-2 MAN CAL
VERNIER	Fully CCW
INPUT	FLTG
POWER	Press to energize instrument

b. The decimal point and 1, 2 or 3 digit should be illuminated on the A9 assembly.

c. Apply 10 volts rms at 500 Hz to the ratio transformer input and set its controls to provide an output of 0.01 volts rms.

d. Slowly increase the ratio transformer output in .1 volt steps, observing that each decimal digit appears on the indicator and the corresponding voltages contained in Figure 4-35 are obtained at the specified A9 assembly terminals.

A9 ASSEMBLY READOUT	TERMINAL VOLTAGES HIGH 7-11V LOW 0.3V				HIGH 2.5-3.6V LOW 0.3V				
	2	3	4	5	6	7	8	9	10
.1	L	H	H	H	L	H	H	H	H
.1	L	H	H	H	L	H	H	H	H
.2	H	L	H	H	H	L	H	H	H
.3	L	L	H	H	L	L	H	H	H
.4	H	H	L	H	H	H	L	H	H
.5	L	H	L	H	L	H	L	H	H
.6	H	L	L	H	H	L	L	H	H
.7	L	L	L	H	L	L	L	H	H
.8	H	H	H	L	H	H	H	L	H
.9	L	H	H	L	L	H	H	L	L

Figure 4-35. 0 TO 9 COUNTER CHECKS

e. Connect the oscilloscope input and ground to A9 terminals 15 and 26, respectively.

f. Alternate the ratio transformer output between the 0.9 and 1.0 volt rms output levels. A negative carry squarewave pulse should momentarily appear on the oscilloscope CRT whenever the 0 digit appears on the A9 indicator.

g. Remove the A9 assembly from the extender board and, using the A9 assembly position in the instrument, repeat the preceding checks on the A7 and A8 assemblies.

4-64. When the results of these checks agree with the information given, the A7 through A9 assemblies are functioning properly. The test equipment can now be disconnected and the assemblies installed in their respective positions in the Model 9500A.

4-65. A6 0-TO-11 COUNTER CHECKS. To perform the following checks, mount the A6 assembly on the extender board and proceed as follows:

a. Place the Model 9500A controls as follows:

RANGE	1
DISPLAY TIME-SEC	.1-2 MAN CAL
VERNIER	Fully CCW
INPUT	FLTG
POWER	Press to energize instrument

b. The decimal point and 0 digit should be illuminated on the A6 assembly.

c. Apply 10 volts rms at 500 Hz to the ratio transformer input and set the ratio transformer output to 0.1 volts rms.

d. Perform the checks described in Figure 4-36, observing that the correct readout and terminal voltages are obtained.

4-66. When the results of these checks agree with the information given, the A6 assembly is functioning properly. The test equipment can now be disconnected and the assembly installed in the Model 9500A.

4-67. The instrument should be fully operational upon the conclusion of the preceding checks and is now ready for calibration. The calibration procedures are contained in paragraphs 4-19 through 4-36.

4-68. SELECTION OF FREQUENCY COMPENSATING COMPONENTS

4-69. INTRODUCTION

4-70. The replacement of a component on the A13 or A14 assemblies found to be defective during the course of troubleshooting may alter the adjustment range or frequency response characteristics of the Model 9500A. Consequently, it may become necessary to replace certain selected components with new components of different values to bring the adjustment range or frequency response characteristics within tolerance. Complete instructions to determine the correct values of these selected components are contained in the following paragraphs.

4-71. CORRECTION OF RANGE AMPLIFIER ADJUSTMENT RANGE

4-72. Upon replacement of components associated with the Range Amplifier circuitry, it may be necessary to alter the value of the capacitors A13C9, A13C12, and A13C13 to bring the adjustment range of the Range Amplifier within tolerance. To select the correct value of these capacitors, proceed as follows:

a. Remove A13C9, A13C12, and A13C13 from the A13 assembly. Refer to Figure 4-37 for location of these components.

b. Place the Model 9500A controls as follows:

RANGE	10
DISPLAY TIME-SEC	.1-2 MAN CAL
VERNIER	Fully CCW
INPUT	FLTG
POWER	Press to energize instrument.

MODEL 9500A RMS INPUT VOLTAGE	A6 ASSEMBLY READOUT	TERMINAL VOLTAGES HIGH 7-11V LOW 0.3V				HIGH 2.5-3.6V LOW 0.3V					H ≅ 75V L = <2V
		2	3	4	5	6	7	8	9	10	15
0.01	.0	H	H	H	H	H	H	H	H	L	H
0.1	.1	L	H	H	H	L	H	H	H	H	H
0.2	.2	H	L	H	H	H	L	H	H	H	H
0.3	.3	L	L	H	H	L	L	H	H	H	H
0.4	.4	H	H	L	H	H	H	L	H	H	H
0.5	.5	L	H	L	H	L	H	L	H	H	H
0.6	.6	H	L	L	H	H	L	L	H	H	H
0.7	.7	L	L	L	H	L	L	L	H	H	H
0.8	.8	H	H	H	L	H	H	H	L	H	H
0.9	.9	L	H	H	L	L	H	H	L	H	H
1.0	A5(1) .0	H	L	H	L	H	L	H	L	H	L
1.1	A5(1) .1	L	L	H	L	L	L	H	L	L	L

Figure 4-36. 0 TO 11 COUNTER CHECKS

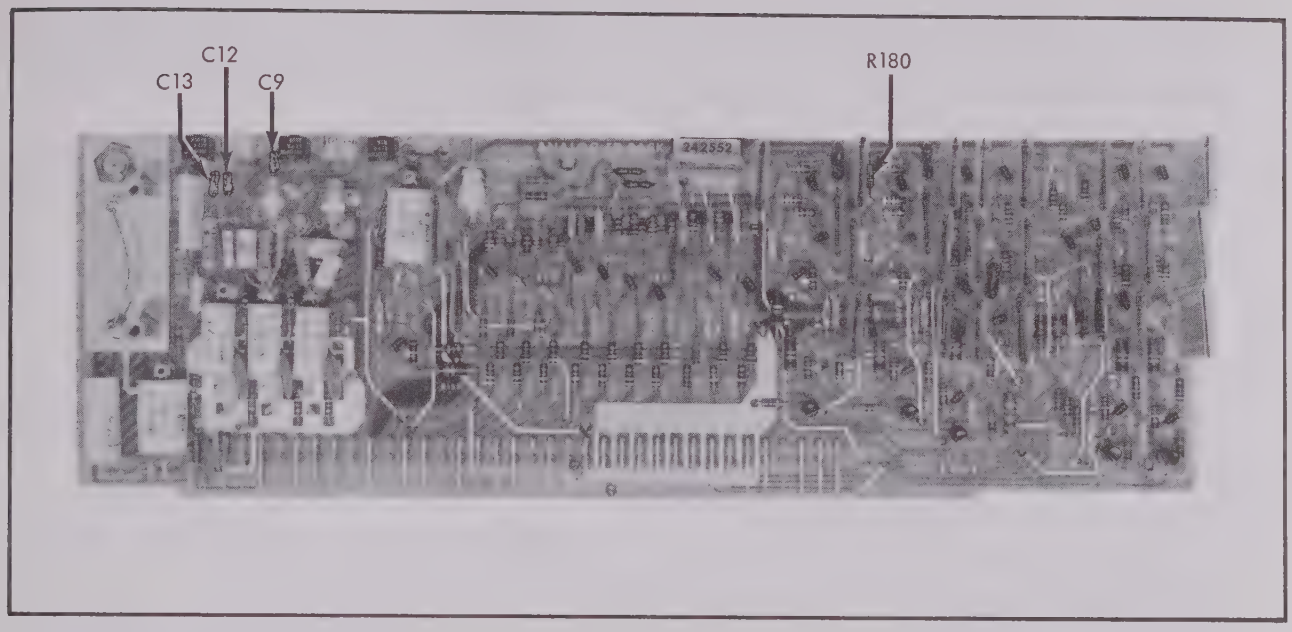


Figure 4-37. LOCATION OF C9, C12, C13, AND R180

c. Apply a 10 volt rms 500 Hz signal, from a calibration source, to the INPUT of the Model 9500A.

d. Adjust the output level of the calibration source to obtain a readout of 10.000 on the Model 9500A and then connect a shorting jumper between A10TP1 and A10TP2.

e. Connect the input of a dc differential voltmeter to A15TP4 and its common lead to the top of A15C11.

f. Apply a 10 volt rms 60 kHz signal, from the calibration source, to the Model 9500A INPUT and adjust A13C7 for maximum positive voltage at A15TP4.

g. Select the value of A13C9 by using the information provided in Figure 4-38.

h. Install the selected capacitor as A13C9 on the A13 assembly.

MAXIMUM VOLTAGE AT A15TP4	A13C9 VALUE (pf)
0 to +170 mv	NONE
+170 to +310 mv	5
+310 to +460 mv	10
+460 to +620 mv	15
+620 to +810 mv	22
+810 to +950 mv	27
+950 to +1130 mv	33
+1130 to +1300 mv	39
+1300 to +1700 mv	47

Figure 4-38. A13C9 PADDER SELECTION

i. Apply a 10 volt rms 50 kHz signal, from the calibration source, to the Model 9500A INPUT and adjust A13C7 for 0 ±0.1 millivolts at A15TP4.

j. Perform the frequency checks described in Figure 4-39, observing that the voltage at A15TP4 is within the specified limits. If the voltage at A15TP4 is not within the specified limit, refer to paragraphs 4-74 through 4-76 for selection of additional compensating networks.

k. Apply a 10 volt rms 50 Hz signal, from the calibration source, to the Model 9500A INPUT and adjust A14R65 for 0 ±0.5 millivolts at A15TP4.

l. Transfer the dc differential voltmeter lead to A14TP4 and adjust A14R22 for 0 ±2 millivolts at A14TP4.

m. Repeat steps k and l until their specified results are obtained.

n. Place the RANGE switch to 100 and apply a 100 volt rms 60 kHz signal, from the calibration source, to the Model 9500A INPUT.

INPUT FREQUENCY (10 VOLTS RMS)	A15TP4 VOLTAGE
500 Hz	0 ± 0.5 mv
10 kHz	0 ± 2.1 mv
30 kHz	0 ± 7.0 mv
700 kHz	0 ± 0.4 volts

Figure 4-39. 10 VOLT RANGE CHECKS

o. Connect the input of a dc differential voltmeter to A15TP4 and its common lead to A15C11.

p. Adjust A13C10 for maximum voltage at A15TP4.

q. Select the value of A13C12 by using the information provided in Figure 4-40.

MAXIMUM VOLTAGE AT A15TP4	A13C12 VALUE (pf)
0 to +230 mv	NONE
+230 to +540 mv	82
+540 to +840 mv	180
+840 to +1120 mv	270
+1120 to +1340 mv	360
+1340 to +1640 mv	430

Figure 4-40. A13C12 PADDER SELECTION

r. Install the selected capacitor as A13C12 on the A13 assembly.

s. Adjust A13C10 for maximum voltage at A15TP4 and select the value of A13C13 using the information provided in Figure 4-41.

MAXIMUM VOLTAGE AT A15TP4	A13C13 VALUE (pf)
0 to +57 mv	NONE
+57 to +113 mv	22
+113 to +164 mv	39
+164 to +199 mv	56
+199 to +240 mv	68
+240 to +290 mv	82
+290 to +330 mv	100

Figure 4-41. A13C13 PADDER SELECTION

t. Install the selected capacitor as A13C13 on the A13 assembly.

u. Apply a 100 volt rms 50 kHz signal, from the calibration source, to the Model 9500A INPUT and adjust A13C10 for 0 ±0.1 millivolts at A15TP4.

v. Perform the frequency checks described in Figure 4-42, observing that the voltage at A15TP4 is within the specified limits. If the voltage at A15TP4 is not within the specified limit, refer to paragraphs 4-74 through 4-76 for selection of additional compensating networks.

INPUT FREQUENCY (100 VOLTS RMS)	A15TP4 VOLTAGE
50 Hz	0 ± 2.1 mv
500 Hz	0 ± 0.5 mv
10 kHz	0 ± 2.1 mv
30 kHz	0 ± 7 mv
700 kHz	0 ± 0.4 volts

Figure 4-42. 100 VOLT RANGE CHECKS

4-73. When the results of these corrections agree with the information given, the instrument is ready for calibration using the procedures described in paragraphs 4-19 through 4-36.

4-74. SELECTION OF FREQUENCY COMPENSATING NETWORK COMPONENTS

4-75. If the frequency response checks of paragraph 4-31 or 4-72 are not within their specified limits, it will be necessary to select values of the components used in the frequency compensating networks of Figure 4-43. To select the values of these components, proceed as follows:

a. Determine the area in need of frequency compensation and remove the associated A13 compensating network components.

b. Repeat the frequency response checks of paragraph 4-31 step u through z and record the resulting voltages at A15TP4.

c. Use the new information of step b to select the values of the compensating network components listed in Figure 4-43.

d. Install the selected network components on the A14 assembly and perform the checks described in paragraph 4-31 step a through z. If necessary, the 50 Hz adjustment A14R65, which affects all ranges equally, may be changed slightly to bring the overall frequency response within the specified limits.

4-76. When the results of these corrections agree with the information given, the instrument is ready for calibration using the procedures described in paragraphs 4-19 through 4-36.

4-77. DIGIT RATIO CHECKS AND COMPENSATION

4-78. Whenever the A13 assembly is repaired or replaced, a complete digit ratio check should be performed. If the results of the digit ratio checks contained in paragraph 4-79 are not obtained, it will be necessary to select a new value for A13R180 in order to bring the digit ratio checks within tolerance.

4-79. DIGIT RATIO CHECKS. To perform the Digit Ratio Checks, proceed as follows:

a. Place the Model 9500A controls as follows:

RANGE	10
DISPLAY TIME-SEC	.1-2 MAN CAL
VERNIER	Fully CCW
INPUT	FLTG
POWER	Press to energize instrument

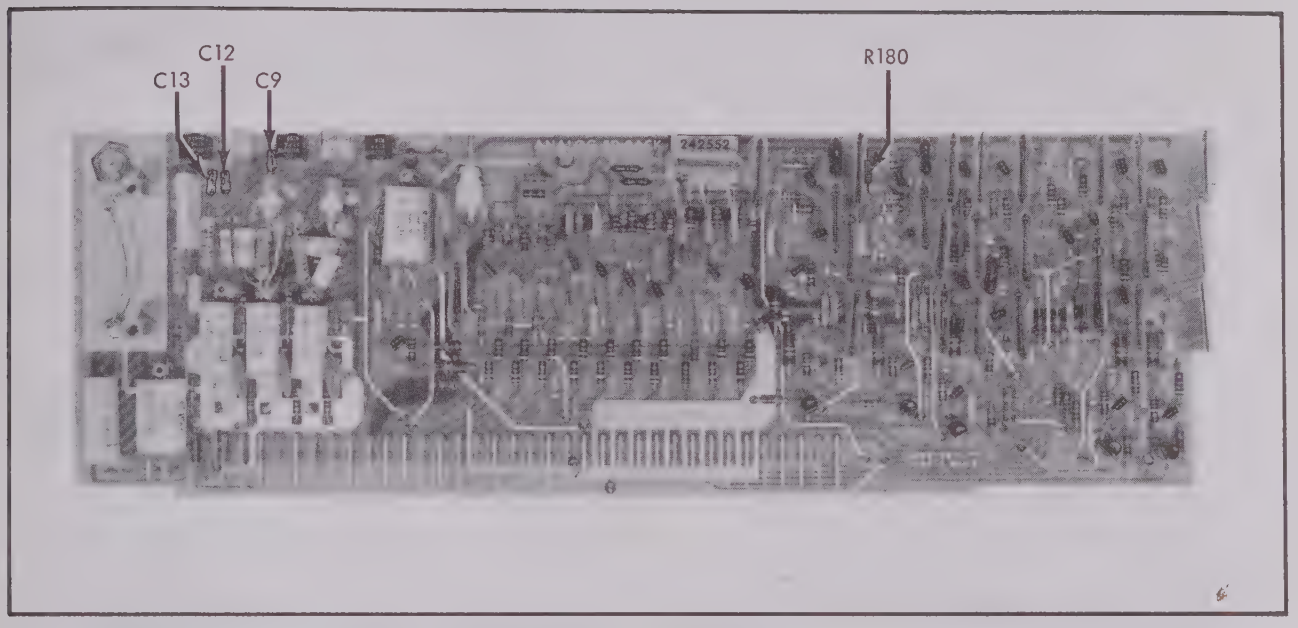


Figure 4-37. LOCATION OF C9, C12, C13, AND R180

c. Apply a 10 volt rms 500 Hz signal, from a calibration source, to the INPUT of the Model 9500A.

d. Adjust the output level of the calibration source to obtain a readout of 10.000 on the Model 9500A and then connect a shorting jumper between A10TP1 and A10TP2.

e. Connect the input of a dc differential voltmeter to A15TP4 and its common lead to the top of A15C11.

f. Apply a 10 volt rms 60 kHz signal, from the calibration source, to the Model 9500A INPUT and adjust A13C7 for maximum positive voltage at A15TP4.

g. Select the value of A13C9 by using the information provided in Figure 4-38.

h. Install the selected capacitor as A13C9 on the A13 assembly.

MAXIMUM VOLTAGE AT A15TP4	A13C9 VALUE (pf)
0 to +170 mv	NONE
+170 to +310 mv	5
+310 to +460 mv	10
+460 to +620 mv	15
+620 to +810 mv	22
+810 to +950 mv	27
+950 to +1130 mv	33
+1130 to +1300 mv	39
+1300 to +1700 mv	47

Figure 4-38. A13C9 PADDER SELECTION

i. Apply a 10 volt rms 50 kHz signal, from the calibration source, to the Model 9500A INPUT and adjust A13C7 for 0 ±0.1 millivolts at A15TP4.

j. Perform the frequency checks described in Figure 4-39, observing that the voltage at A15TP4 is within the specified limits. If the voltage at A15TP4 is not within the specified limit, refer to paragraphs 4-74 through 4-76 for selection of additional compensating networks.

k. Apply a 10 volt rms 50 Hz signal, from the calibration source, to the Model 9500A INPUT and adjust A14R65 for 0 ±0.5 millivolts at A15TP4.

l. Transfer the dc differential voltmeter lead to A14TP4 and adjust A14R22 for 0 ±2 millivolts at A14TP4.

m. Repeat steps k and l until their specified results are obtained.

n. Place the RANGE switch to 100 and apply a 100 volt rms 60 kHz signal, from the calibration source, to the Model 9500A INPUT.

INPUT FREQUENCY (10 VOLTS RMS)	A15TP4 VOLTAGE
500 Hz	0 ± 0.5 mv
10 kHz	0 ± 2.1 mv
30 kHz	0 ± 7.0 mv
700 kHz	0 ± 0.4 volts

Figure 4-39. 10 VOLT RANGE CHECKS

o. Connect the input of a dc differential voltmeter to A15TP4 and its common lead to A15C11.

p. Adjust A13C10 for maximum voltage at A15TP4.

q. Select the value of A13C12 by using the information provided in Figure 4-40.

MAXIMUM VOLTAGE AT A15TP4	A13C12 VALUE (pf)
0 to +230 mv	NONE
+230 to +540 mv	82
+540 to +840 mv	180
+840 to +1120 mv	270
+1120 to +1340 mv	360
+1340 to +1640 mv	430

Figure 4-40. A13C12 PADDER SELECTION

r. Install the selected capacitor as A13C12 on the A13 assembly.

s. Adjust A13C10 for maximum voltage at A15TP4 and select the value of A13C13 using the information provided in Figure 4-41.

MAXIMUM VOLTAGE AT A15TP4	A13C13 VALUE (pf)
0 to +57 mv	NONE
+57 to +113 mv	22
+113 to +164 mv	39
+164 to +199 mv	56
+199 to +240 mv	68
+240 to +290 mv	82
+290 to +330 mv	100

Figure 4-41. A13C13 PADDER SELECTION

t. Install the selected capacitor as A13C13 on the A13 assembly.

u. Apply a 100 volt rms 50 kHz signal, from the calibration source, to the Model 9500A INPUT and adjust A13C10 for 0 ±0.1 millivolts at A15TP4.

v. Perform the frequency checks described in Figure 4-42, observing that the voltage at A15TP4 is within the specified limits. If the voltage at A15TP4 is not within the specified limit, refer to paragraphs 4-74 through 4-76 for selection of additional compensating networks.

INPUT FREQUENCY (100 VOLTS RMS)	A15TP4 VOLTAGE
50 Hz	0 ± 2.1 mv
500 Hz	0 ± 0.5 mv
10 kHz	0 ± 2.1 mv
30 kHz	0 ± 7 mv
700 kHz	0 ± 0.4 volts

Figure 4-42. 100 VOLT RANGE CHECKS

4-73. When the results of these corrections agree with the information given, the instrument is ready for calibration using the procedures described in paragraphs 4-19 through 4-36.

4-74. SELECTION OF FREQUENCY COMPENSATING NETWORK COMPONENTS

4-75. If the frequency response checks of paragraph 4-31 or 4-72 are not within their specified limits, it will be necessary to select values of the components used in the frequency compensating networks of Figure 4-43. To select the values of these components, proceed as follows:

a. Determine the area in need of frequency compensation and remove the associated A13 compensating network components.

b. Repeat the frequency response checks of paragraph 4-31 step u through z and record the resulting voltages at A15TP4.

c. Use the new information of step b to select the values of the compensating network components listed in Figure 4-43.

d. Install the selected network components on the A14 assembly and perform the checks described in paragraph 4-31 step a through z. If necessary, the 50 Hz adjustment A14R65, which affects all ranges equally, may be changed slightly to bring the overall frequency response within the specified limits.

4-76. When the results of these corrections agree with the information given, the instrument is ready for calibration using the procedures described in paragraphs 4-19 through 4-36.

4-77. DIGIT RATIO CHECKS AND COMPENSATION

4-78. Whenever the A13 assembly is repaired or replaced, a complete digit ratio check should be performed. If the results of the digit ratio checks contained in paragraph 4-79 are not obtained, it will be necessary to select a new value for A13R180 in order to bring the digit ratio checks within tolerance.

4-79. DIGIT RATIO CHECKS. To perform the Digit Ratio Checks, proceed as follows:

a. Place the Model 9500A controls as follows:

RANGE	10
DISPLAY TIME-SEC	.1-2 MAN CAL
VERNIER	Fully CCW
INPUT	FLTG
POWER	Press to energize instrument

LOW FREQUENCY COMPENSATING NETWORK (10 kHz to 30 kHz)				HIGH FREQUENCY COMPENSATING NETWORK (700 kHz)		
COMPONENTS		RESPONSE CHANGE		COMPONENTS		RESPONSE CHANGE
A14R87	A14C36	10 kHz	30 kHz	A14R88	A14C35	700 kHz
270 k	30 pf	-120 ppm	-200 ppm	6.8k	56 pf	-2%
				3.9k	100 pf	-4%
Notes: 70 ppm = 1 mv 1% = 75 mv						

Figure 4-43. SELECTION OF FREQUENCY COMPENSATING NETWORK COMPONENTS

b. Apply a 10 volt rms 500 Hz signal, from an ac calibration source, to the input of a ratio transformer.

c. Set the ratio transformer output to 10 volts rms.

d. Apply the ratio transformer output to the Model 9500A INPUT.

e. Adjust the ac calibration source output to obtain a readout of 10.000 on the Model 9500A and then connect a shorting jumper between A10TP1 and TP2.

f. Connect the input of a dc differential voltmeter to A15TP4 and its common lead to the top of A15C11.

g. Adjust the ac calibration source output level to obtain 0 ±0.3 millivolts at A15TP4.

h. Perform the checks indicated in Figure 4-44, setting the Model 9500A to the appropriate readout by shorting A10TP1 to A10TP2, and observing that the voltage at A15TP4 is within the specified limits. If the specified results are not obtained, refer to paragraph 4-81 for digit ratio compensating information.

4-80. When the results of these checks agree with the information given, the instrument is operating normally and the test equipment can be disconnected from the instrument.

4-81. DIGIT RATIO COMPENSATION. Whenever the specified limits of the digit ratio checks are not obtained, a new value for the compensating resistor A13R180 must be selected. Upon selection of a new value for A13R180, the digit ratio checks of paragraph 4-79 must then be repeated to ensure that the specified limits are obtained. To select the value of A13R180, proceed as follows:

a. Remove A13R180 from the A13 assembly. Refer to Figure 4-37 for location of A13R180.

RATIO TRANSFORMER OUTPUT AND MODEL 9500A READOUT	A15TP4 SPECIFIED VOLTAGE
10.000	Set ac source to 0 ± 0.3 mv
9.000	0 ± 0.7 mv
8.000	0 ± 0.7 mv
7.000	0 ± 0.7 mv
6.000	0 ± 0.7 mv
5.000	0 ± 1 mv
4.000	0 ± 1.4 mv
3.000	
2.000	0 ± 2.8 mv
1.000	0 ± 5.6 mv
1.000	Set ac source to 0 ± 0.3 mv
1.100	0 ± 2 mv
1.200	0 ± 2 mv
1.400	0 ± 3 mv
1.800	0 ± 4 mv
1.010	0 ± 2 mv
1.020	0 ± 2 mv
1.040	0 ± 2 mv
1.080	0 ± 2 mv
1.001	0 ± 2 mv
1.002	0 ± 2 mv
1.004	0 ± 2 mv
1.008	0 ± 2 mv

Figure 4-44. DIGIT RATIO CHECKS

b. Place the Model 9500A controls as follows:

RANGE	10
DISPLAY TIME-SEC	.1-2 MAN CAL
VERNIER	Fully CCW
INPUT	FLTG
POWER	Press to energize instrument

c. Apply a 10 volt rms 500 Hz signal, from an ac calibration source, to the input of a ratio transformer.

d. Set the ratio transformer output to 10 volts rms.

e. Apply the ratio transformer output to the Model 9500A INPUT.

f. Adjust the ac calibration source output level to obtain a readout of 10.000 on the Model 9500A and then connect a shorting jumper between A10TP1 and TP2.

g. Connect the input of a dc differential voltmeter to A15TP4 and its common lead to the top of A15C11.

h. Adjust the ac calibration source output level to obtain 0 ±0.3 millivolts at A15TP4.

i. Perform the checks described in Figure 4-45, stopping the Model 9500A readout at the appropriate readout by shorting A10TP1 to A10TP2, and record the resulting voltages at A15TP4.

j. Combine the information recorded in step i using the following formula:

$$\triangle = V_9 + V_8 - V_7 - V_6 - V_5$$

RATIO TRANSFORMER OUTPUT AND MODEL 9500A READOUT	VOLTAGE AT A15TP4
10.000	Set to 0 ± 0.3 mv
09.000	V_9
08.000	V_8
07.000	V_7
06.000	V_6
05.000	V_5

Figure 4-45. DIGIT RATIO COMPENSATION VOLTAGE MEASUREMENTS

k. Determine the value of A13R180 using the result of step j and the information contained in Figure 4-46.

l. Install the selected resistor as A13R180 on the A13 assembly.

m. Repeat the digit ratio checks of paragraph 4-79.

4-82. When the results of this compensation selection agree with the information given, the instrument is operating normally. The test equipment can now be disconnect from the instrument or, if calibration was in progress when this selection was performed, the calibration procedure continued.

RESULT OF STEP j. (△)	A13R180 VALUE (1/4 WATT)
+0.7 mv	NONE
+0.7 to +1.7 mv	12 Megohm
+1.7 to +2.5 mv	6.2 Megohm
+2.5 to +3.6 mv	4.3 Megohm
+3.6 to +5.0 mv	3.3 Megohm
+5.0 to +6.5 mv	2.4 Megohm

Figure 4-46. DIGIT RATIO COMPENSATING RESISTOR VALUES

SECTION V

LIST OF REPLACEABLE PARTS

5-1. INTRODUCTION

5-2. This section of the manual contains a listing of replaceable components for this instrument. The first listing contains a complete breakdown of all the major assemblies followed by subsequent listings that itemize the components on each major assembly. An illustration accompanies each major assembly listing to aid in locating the listed components.

5-3. Assemblies and subassemblies are identified by a reference designation beginning with the letter A followed by a number (e.g., A1 etc.). Electrical components appearing on the schematic diagram are identified by their schematic diagram reference designation. Components not appearing on the schematic diagram are consecutively numbered throughout the parts list. These components are identified with whole numbers on the arrow call-out illustrations and by index numbers on the grid illustrations. Flagnotes are used throughout the parts list and refer to special ordering explanations that are located in close proximity to the flagnotes.

5-4. COLUMN DESCRIPTIONS

a. The REF DESIG column indexes the item description to the associated illustration. In general the reference designations are listed under each assembyl in alpha-numeric order. Subassemblies of minor proportions are sometimes listed with the assembly of which they are a part. In this case, the reference designations for the components of the subassembly may appear out of order.

b. The INDEX NO. column lists coordinates which locate the designated part on the associated grid illustrations.

c. The DESCRIPTION column describes the salient characteristics of the component. Indention of the description indicates the relationship to other assemblies, components, etc. In many cases it is necessary to abbreviate in this column. For abbreviations and symbols used, see the following page.

d. The ten-digit part number by which the item is identified at the John Fluke Mfg. Co. is listed in the STOCK NO. column. Use this number when ordering parts from the factory or authorized representatives.

e. The Federal Supply Code for the item manufacturer is listed in the MFR column. An abbreviated list of Federal Supply Codes is included in the Appendix.

f. The part number which uniquely identifies the item to the original manufacturer is listed in the MFR PART NO column. If a component must be ordered by description, the type number is listed.

g. Entries in the TOT QTY column indicate the total quantity of parts used. The totals given in parts lists for the module are totals for that module: totals given in the final assembly list are totals for the final assembly. The total quantity of each part is listed the first time the part appears. REF indicates that the total quantity of the part has been listed previously.

h. Entries in the REC QTY column indicate the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one of every P/C assembly contained in the instrument be stocked. The REC QTY column lists the recommended quantity of the item in that particular assembly.

i. The USE CODE column identifies certain parts which have been added, deleted or modified during the production of the instrument. Each part for which a Use Code has been assigned may be identified with a particular instrument serial number by consulting the Serial Number Effectivity List at the end of the parts list. Sometimes when a part is changed, the new part can and should be used as a replacement for the original part. In this event a parenthetical note is added in the DESCRIPTION column.

5-5. HOW TO OBTAIN PARTS

5-6. Standard components have been used wherever possible. Standard components may be ordered directly from the manufacturer by using the manufacturer's part number, or parts may be ordered from the John Fluke Mfg. Co. factory or authorized representative by using the Fluke part number. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

5-7. You can insure prompt and efficient handling of your order to the John Fluke Mfg. Co. if you include the following information:

a. Quantity.

b. FLUKE Stock Number.

c. Description.

d. Reference Designation.

e. Instrument model and serial number.

Example: 2 each, 4805-177105, Transistors, 2N3565, Q107-108 for 845AR, s/n 168.

If you must order structural parts not listed in the parts list, describe the part as completely as possible. A sketch of the part showing its location to other parts of the instrument is usually most helpful.

5-8. LIST OF ABBREVIATIONS

ac	alternating current
Al	Aluminum
amp	ampere
assy	assembly
cap	capacitor
car flm	carbon film
C	centigrade
cer	ceramic
comp	composition
conn	connector
db	decibel
dc	direct current
dpdt	double-pole, double-throw
dpst	double-pole, single-throw
elect	electrolytic
F	fahrenheit
Ge	germanium
gmv	guaranteed minimum value
h	henry
Hz	hertz
hf	high frequency
IC	integrated circuit
if	intermediate frequency
k	kilohm
kHz	kilohertz
kv	kilovolt
lf	low frequency
MHz	megahertz
M	megohm
met flm	metal film
ua	microampere
uf	microfarad
uh	microhenry
usec	microsecond
uv	microvolt
ma	milliampere
mh	millihenry
m	milliohms
msec	millisecond
mv	millivolt
mw	milliwatt
na	nanoampere
nsec	nanosecond
nv	nanovolt
Ω	ohm
ppm	parts per million
piv	peak inverse voltage
p-p	peak to peak
pf	picofarad
plstc	plastic
p	pole
pos	position
P/C	printed circuit
rf	radio frequency
rfi	radio frequency interference
res	resistor
rms	root mean square
rtry	rotary
sec	second
sect	section
S/N	serial number
Si	silicon
scr	silicon controlled rectifier
spdt	single-pole, double-throw
spst	single-pole, single-throw
sw	switch
Ta	tantalum
tstr	transistor
tvm	transistor voltmeter
uhf	ultra high frequency
vtvm	vacuum tube voltmeter
var	variable
vhf	very high frequency
vlf	very low frequency
v	volt
va	voltampere
vac	volts, alternating current
vdc	volts, direct current
w	watt
ww	wire wound

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		RMS DIGITAL VOLTMETER-Figure 5-1	9500A					
A1		Power Supply "A" P/C Assembly (See Figure 5-2)	1702-226522 (9500A-4001)	89536	1702-226522	1		
A2		Power Supply "B" P/C Assembly (See Figure 5-3)	1702-226530 (9500A-4002)	89536	1702-226530	1		
A5		Range Logic P/C Assembly (See Figure 5-4)	1702-226563 (9500A-4005)	89536	1702-226563	1		C
A5		Range Logic P/C Assembly (See Figure 5-5)	1702-239913 (9500A-4025)	89536	1702-239913	1		D
A6		0-11 Counter P/C Assembly (See Figure 5-6)	1702-226571 (9500A-4006)	89536	1702-226571	1		C
A6		0-11 Counter P/C Assembly (See Figure 5-7)	1702-239921 (9500A-4026)	89536	1702-239921	1		D
A7		0-9 Counter P/C Assembly (See Figure 5-8)	1702-226589 (9500A-4007)	89536	1702-226589	3		C
A7		0-9 Counter P/C Assembly (See Figure 5-9)	1702-239939 (9500A-4027)	89536	1702-239939	3		D
A8		0-9 Counter P/C Assembly (See Figure 5-8)	1702-226589 (9500A-4007)	89536	1702-226589	REF		C
A8		0-9 Counter P/C Assembly (See Figure 5-9)	1702-239939 (9500A-4027)	89536	1702-239939	REF		D
A9		0-9 Counter P/C Assembly (See Figure 5-8)	1702-226589 (9500A-4007)	89536	1702-226589	REF		C
A9		0-9 Counter P/C Assembly (See Figure 5-9)	1702-239939 (9500A-4027)	89536	1702-239939	REF		D
A10		Control Logic P/C Assembly (See Figure 5-10)	1702-226597 (9500A-4010)	89536	1702-226597	1		C
A10		Control Logic P/C Assembly (See Figure 5-11)	1702-239947 (9500A-4028)	89536	1702-239947	1		D
A11		Calibration Logic P/C Assembly (See Figure 5-12)	1702-226605 (9500A-4011)	89536	1702-226605	1		C
A11		Calibration Logic P/C Assembly (See Figure 5-13)	1702-239954 (9500A-4029)	89536	1702-239954	1		D
A12		Sample Circuits P/C Assembly (See Figure 5-14)	1702-226613 (9500A-4012)	89536	1702-226613	1		C
A12		Sample Circuits P/C Assembly (See Figure 5-15)	1702-239962 (9500A-4030)	89536	1702-239962	1		D
A13		Analog Feedback P/C Assembly (See Figure 5-16)	1702-242545 (9500A-4023)	89536	1702-242545	1		
A14		Analog Amplifier Circuits P/C Assembly (See Figure 5-17)	1702-226639 (9500A-4014)	89536	1702-226639	1		

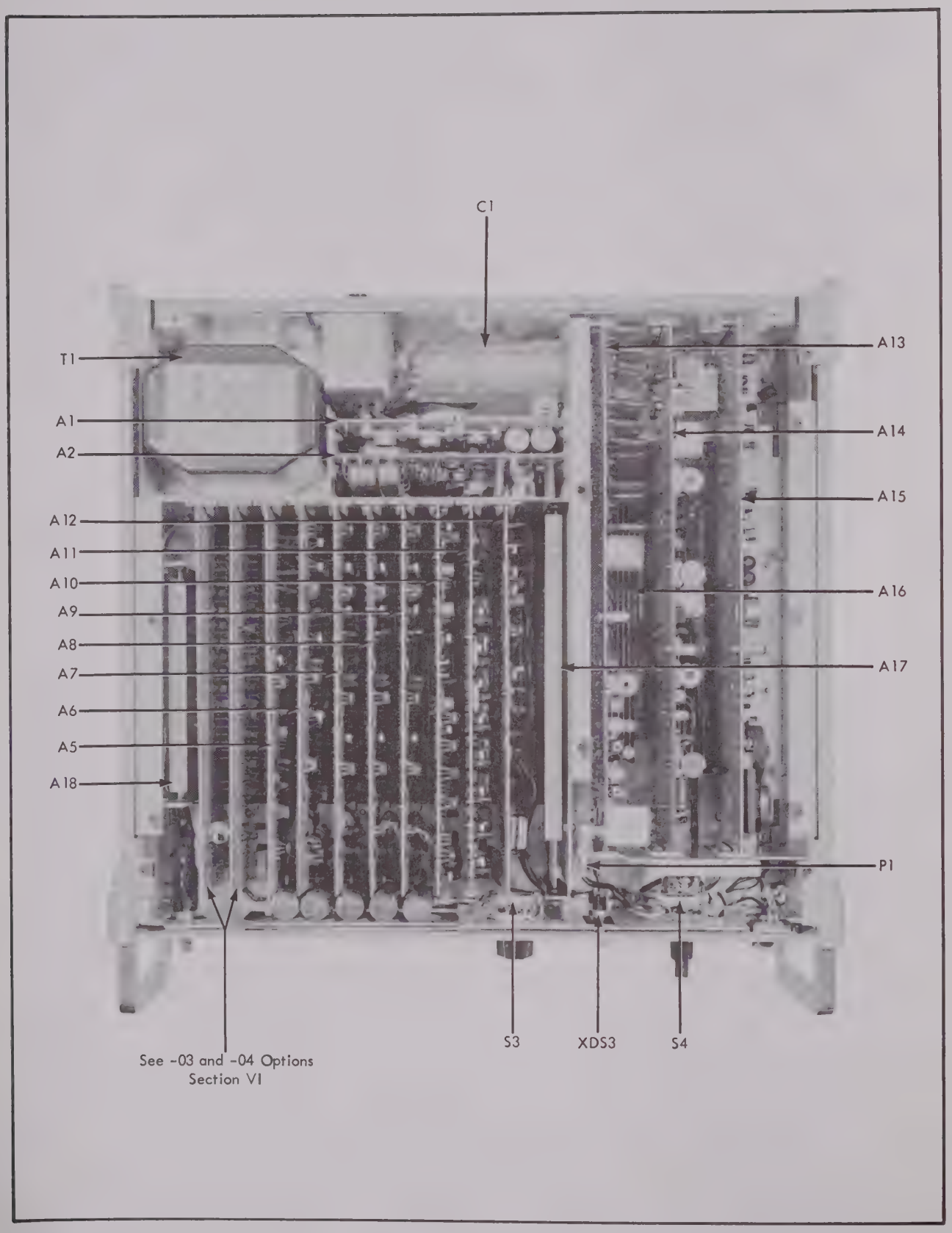


Figure 5-1. 9500A RMS DIGITAL VOLTMETER (Sheet 1 of 2)

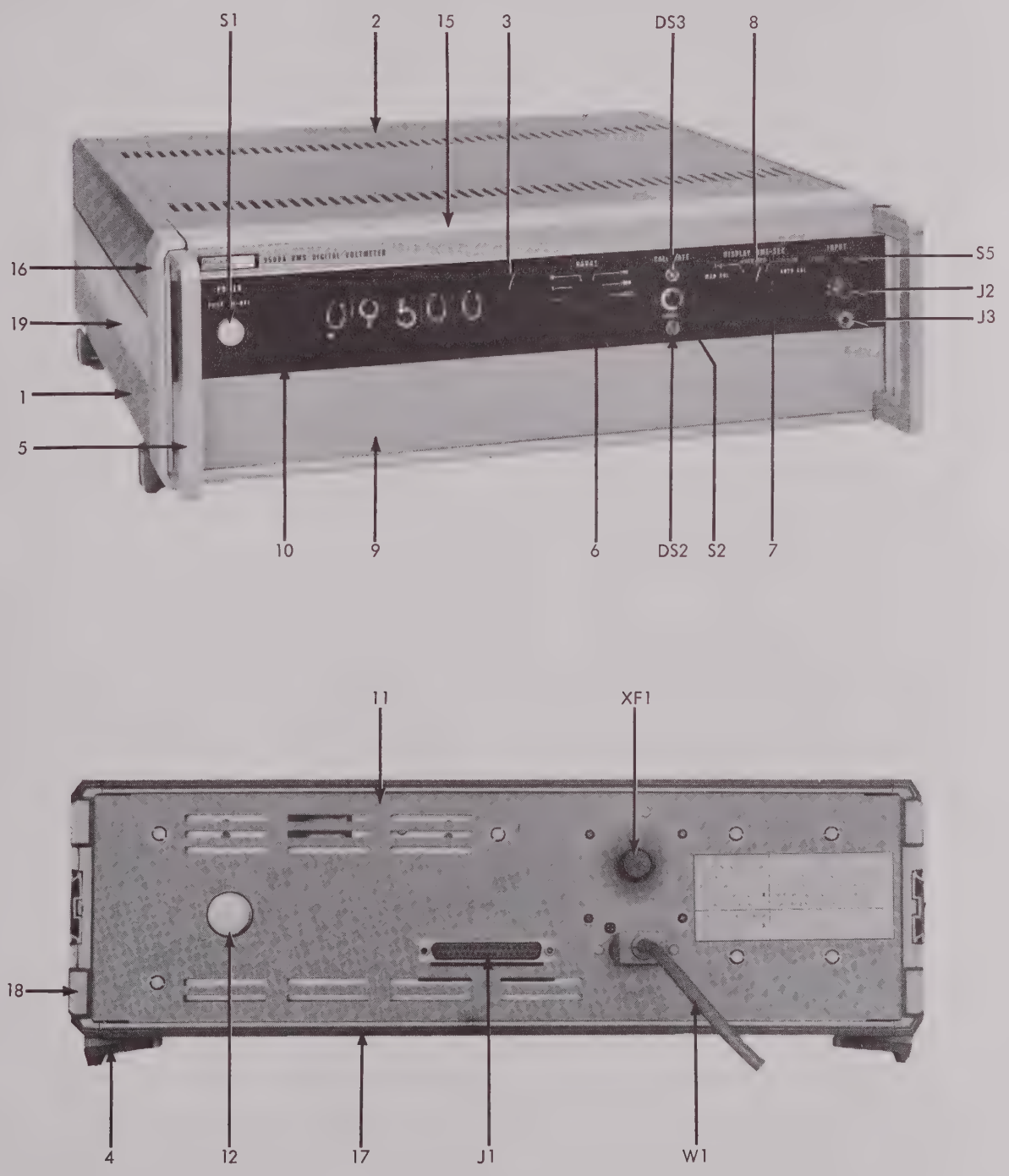


Figure 5-1. 9500A RMS DIGITAL VOLTMETER (Sheet 2 of 2)

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A15		Null Detector P/C Assembly (See Figure 5-18)	1702-226647 (9500A-4015)	89536	1702-226647	1		
A16		Mother Board P/C Assembly (See Figure 5-19)	1702-226654 (9500A-4016)	89536	1702-226654	1		
A17		Extender Printed Circuit Board, 35 contact	1702-227520 (9500A-4017)	89536	1702-227520	1		
A18		Extender Printed Circuit Board, 22 contact	1702-228080 (9500A-4018)	89536	1702-228080	1		
C1		Cap, elect, 10,000 uf, +100/-10%, 10v	1502-229922	56289	36D47669	1	1	
DS1		Lamp, incandesent, 14v (inside S1)	3901-234864	71744	CM382	1	2	
DS2		Lamp, neon cartridge	3903-234567	71744	CML60301C	2		
DS3		Lamp, neon cartridge	3903-234567	71744	CML60301C	REF		
F1		Fuse, Fast acting, 3/4 amp, 250v (for 115v operation) (not illustrated)	5101-109249	71400	Type AGC	1	5	
F1		Fuse, Fast acting, 1/2 amp, 250v (for 230v operation) (not illustrated)	5101-153858	71400	Type AGC	1	5	
J1		Connector, female, 37 contact	2105-235085	71785	DC37S	1		
J2		Connector, female, BNC	2104-144667	02660	UG290A/U	1		
J3		Binding post, grounding						
		Cap, brass	2811-225615	20584	3575	1		
		Post, brass	2811-225623	20584	3576	1		
P1		Connector, male, coaxial	2106-229021	95712	DM40257-1	1		
Q1		Tstr, silicon, NPN (underneath C1)	4805-170787	95303	2N3054	2	1	
Q2		Tstr, silicon, NPN (underneath C1)	4805-170787	95303	2N3054	REF		
S1		Switch, push button, spdt, POWER	5104-222604	87034	SW616-27	1		
S2		Switch, push button, spdt, CALIBRATE	5104-222729	82389	913	1		
S3		Switch, rotary, RANGE	5107-234534	89536	5107-234534	1		
S4		Switch, rotary, DISPLAY TIME	5107-234229	89536	5107-234229	1		
S5		Switch, slide, spst, INPUT	5100-234559	78488	Type SS-26	1		
T1		Transformer, power	5602-228106	89536	5602-228106	1		
W1		Line cord	6005-226100	89536	6005-226100	1		
XDS2		Socket, lamp (below XDS3)	2110-229336	03797	2K	2		
XDS3		Socket, lamp	2110-229336	03797	2K	REF		
XF1		Holder, fuse	2102-100107	71400	HKP	1		
1		Cover, bottom	3156-239590	89536	3156-239590	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
2		Cover, top	3156-239582	89536	3156-239582	1		
3		Filter, optical	2700-224147	89536	2700-224147	1		
4		Foot, plastic	3155-230037	89536	3155-230037	4		
5		Handle	3151-231654	89536	3151-231654	2		
6		Knob, RANGE	2405-158956	89536	2405-158956	1		
		Knob, SAMPLE						
7		Knob, bar	2405-162347	89536	2405-162347	1		
8		Knob, vernier	2405-241018	89536	2405-241018	1		
9		Panel, front	1406-225235	89536	1406-225235	1		
10		Panel, front screened trim	3156-225342	89536	3156-225342	1		
11		Panel, rear	3156-225326	89536	3156-225326	1		
12		Plug button, snap, 3/4"	2109-242156	83330	655	1		
13		Rack Mounting Kit (not illustrated)	2906-243295	89536	2906-243295	1		
14		Tilt stand (not illustrated)	3154-231407	89536	3154-231407	1		
15		Trim strip, front	3154-230813	89536	3154-230813	2		
16		Trim strip, front corner	3151-239780	89536	3151-239780	2		
17		Trim strip, rear	3154-230821	89536	3154-230821	2		
18		Trim strip, rear corner	3151-239798	89536	3151-239798	2		
19		Trim strip, side insert	3155-230896	89536	3155-230896	2		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A1		**POWER SUPPLY "A" P/C ASSEMBLY** Figure 5-2	1702-226522 (9500A-4001)	89536	1702-226522	REF		
C1	D4-S5	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	4	1	
C2	D5-Q4	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	REF		
C3	C5-S3	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	REF		
C4	F2-Q4	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
C5	F5-Q1	Cap, elect, 250 uf +50/-10%, 16v	1502-187765	73445	C437ARE250	1	1	
C6	I2-R2	Cap, elect, 4 uf +50/-10%, 350v	1502-241398	37942	TCW004T350-P2B	1	1	
C7	C5-Q3	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	REF		
CR1	I4-Q2	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	4	1	
CR2	H4-Q2	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	REF		
CR3	I2-Q2	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	REF		
CR4	I1-Q2	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	REF		
CR5	J1-P5	Diode, silicon, 3 amp, 200 piv	4802-187716	04713	MR1032B	2	1	
CR6	J1-Q3	Diode, silicon, 3 amp, 200 piv	4802-187716	04713	MR1032B	REF		
CR7	E4-S5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	2	1	
CR8	F3-S5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
P1	F1-P2	Connector, 22 contact	2816-234914	91662	02-022-013-5-200	1		
Q1	G5-Q5	Tstr, silicon, PNP	4805-169375	04713	MPS3638	1	1	
Q2	G5-S4	Tstr, silicon, PNP	4805-190389	04713	SM4144	1	1	
Q3	E4-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	2	1	
Q4	F3-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q5	F1-T4	Tstr, silicon, NPN	4805-190710	04713	2N3739	3	1	
Q6	I2-T4	Tstr, silicon, NPN	4805-190710	04713	2N3739	REF		
Q7	G3-T4	Tstr, silicon, NPN	4805-190710	04713	2N3739	REF		
R1	G3-R3	Res, ww, 0.3Ω ±5%, 2w	4706-219410	75042	Type BWH	2		
R2	H1-S1	Res, comp, 1K ±5%, 1/4w	4704-148023	01121	CB1025	1		
R3	E3-R4	Res, met flm, 806Ω ±1%, 1/2w	4705-150698	75042	Type CEC-TO	1		
R4	E4-R4	Res, met flm, 1K ±1%, 1/2w	4705-151324	75042	Type CEC-TO	2		
R5	F1-R5	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	1		

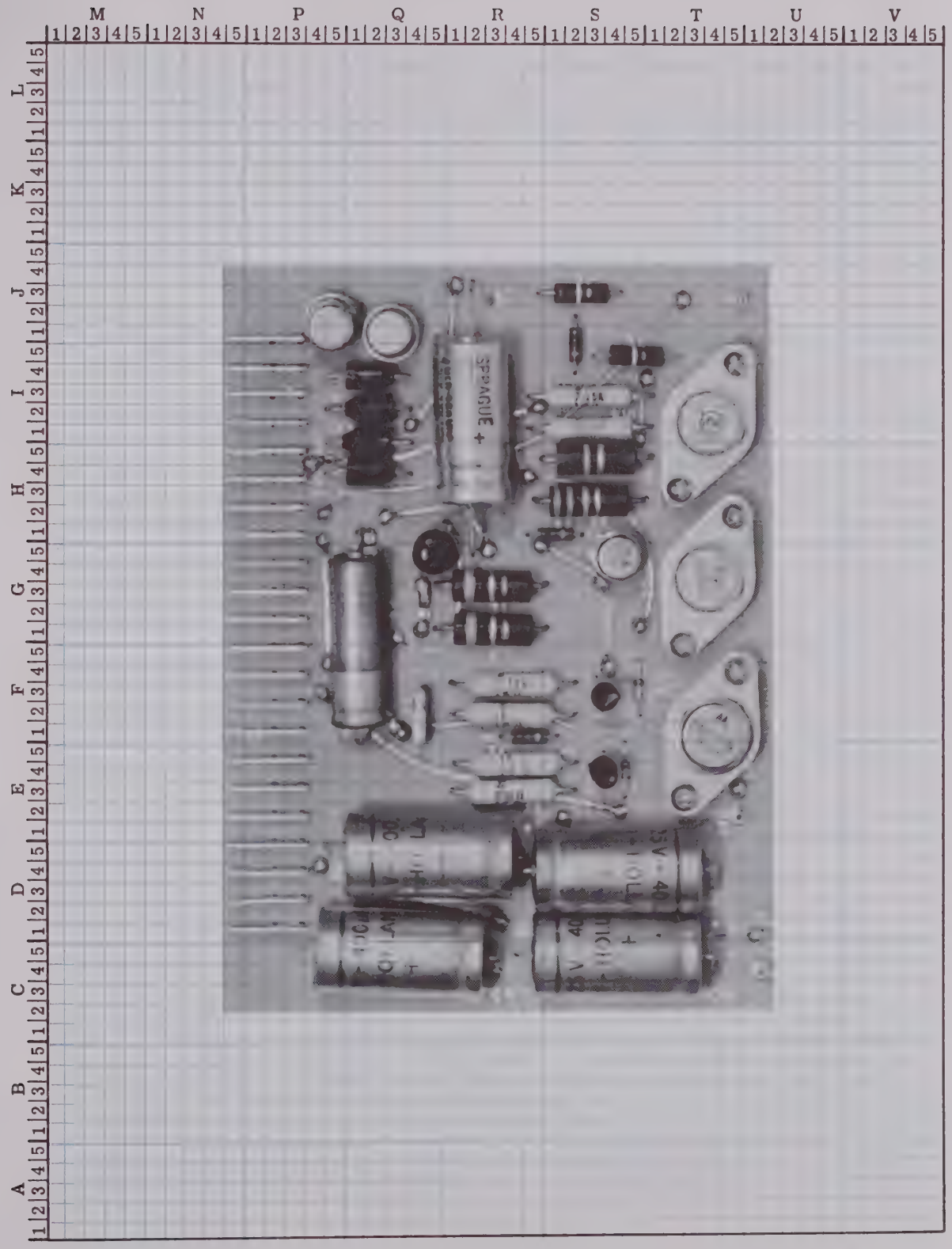


Figure 5-2. POWER SUPPLY "A" P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R6	F2-R4	Res, met flm, 1K ±1%, 1/2w	4705-151324	75042	Type CEC-TO	REF		
R7	F3-R4	Res, met flm, 6.49k ±1%, 1/2w	4705-217968	75042	Type CEC-TO	1		
R8	H3-S3	Res, comp, 33K ±10%, 1w	4704-109538	01121	GB3331	1		
R9	H5-S3	Res, comp, 22k ±10%, 1w	4704-109470	01121	GB2231	1		
R10	I1-S3	Res, met flm, 80.6k ±1%, 1/2w	4705-150680	75042	Type CEC-TO	1		
R11	I3-S3	Res, met flm, 7.15k ±1%, 1/2w	4705-186072	75042	Type CEC-TO	1		
R12	I5-S2	Res, comp, 15Ω ±5%, 1/4w	4704-147876	01121	CB1505	1		
R13	G1-R3	Res, ww, 0.3Ω ±5%, 2w	4706-219410	75042	Type BWH	REF		
R14	J3-S2	Res, comp, 100k ±5%, 1/2w	4704-168054	01121	EB1045	2		
R15	I5-S5	Res, comp, 100k ±5%, 1/2w	4704-168054	01121	EB1045	REF		
		Transipad, nylon	3155-152207	17069	88000	2		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A2		**POWER SUPPLY "B" P/C ASSEMBLY Figure 5-3**	1702-226530 (9500A-4002)	89536	1702-226530	REF		
C1	C2-P3	Cap, elect, 640 uf +50/-10%, 25v	1502-218172	73445	C437ARF640	3	1	
C2	C5-P3	Cap, elect, 640 uf +50/-10%, 25v	1502-218172	73445	C437ARF640	REF		
C3	E1-P2	Cap, elect, 640 uf +50/-10%, 25v	1502-218172	73445	C437ARF640	REF		
C4	E2-T4	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	2		
C5	F2-U1	Cap, Ta, 10 uf ±20%, 15v	1508-193623	56289	196D106X0015	1		
C6	E5-P2	Cap, elect, 400 uf +50/-10%, 25v	1502-168153	73445	C437ARF400	1	1	
C7	D2-S4	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
CR1	C4-Q5	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	4	1	
CR2	C3-Q5	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	REF		
CR3	B5-Q5	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	REF		
CR4	C1-Q5	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	REF		
CR5	D3-U2	Diode, zener, matched	1					
P1	B2-P5	Connector, 18 contact	2816-234906	91662	02-018-013-5-200	1		
Q1	D5-S3	Tstr, silicon, PNP	4805-190389	04713	SM4144	2	1	
Q2	J4-R2	Tstr, silicon, PNP	4805-190389	04713	SM4144	4	1	A
Q2	D4-R4	Tstr, silicon, PNP	4805-245605	04713	2N4898	1	1	B
Q3	J4-R4	Tstr, silicon, PNP	4805-190389	04713	SM4144	REF		A
Q4	E4-R4	Tstr, silicon, PNP	4805-169375	04713	MPS3638	3	1	
Q5	E4-S1	Tstr, silicon, NPN	4805-168708	03508	2N3391	6	2	
Q6	E5-Q3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q7	E4-R1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q8	E1-T3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q9	D5-U1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q10	D2-S2	Tstr, silicon, PNP	4805-169375	04713	MPS3638	REF		
Q11	D2-T1	Tstr, silicon, PNP	4805-169375	04713	MPS3638	REF		
Q12	C5-R3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q13	C2-S2	Tstr, silicon, NPN	4805-170787	95303	2N3054	1	1	
Q14	E1-Q4	Tstr, silicon, PNP	4805-190389	04713	SM4144	REF		
R1	E2-Q4	Res, comp, 3Ω ±5%, 1/4w	4704-218040	01121	CB30G5	1		

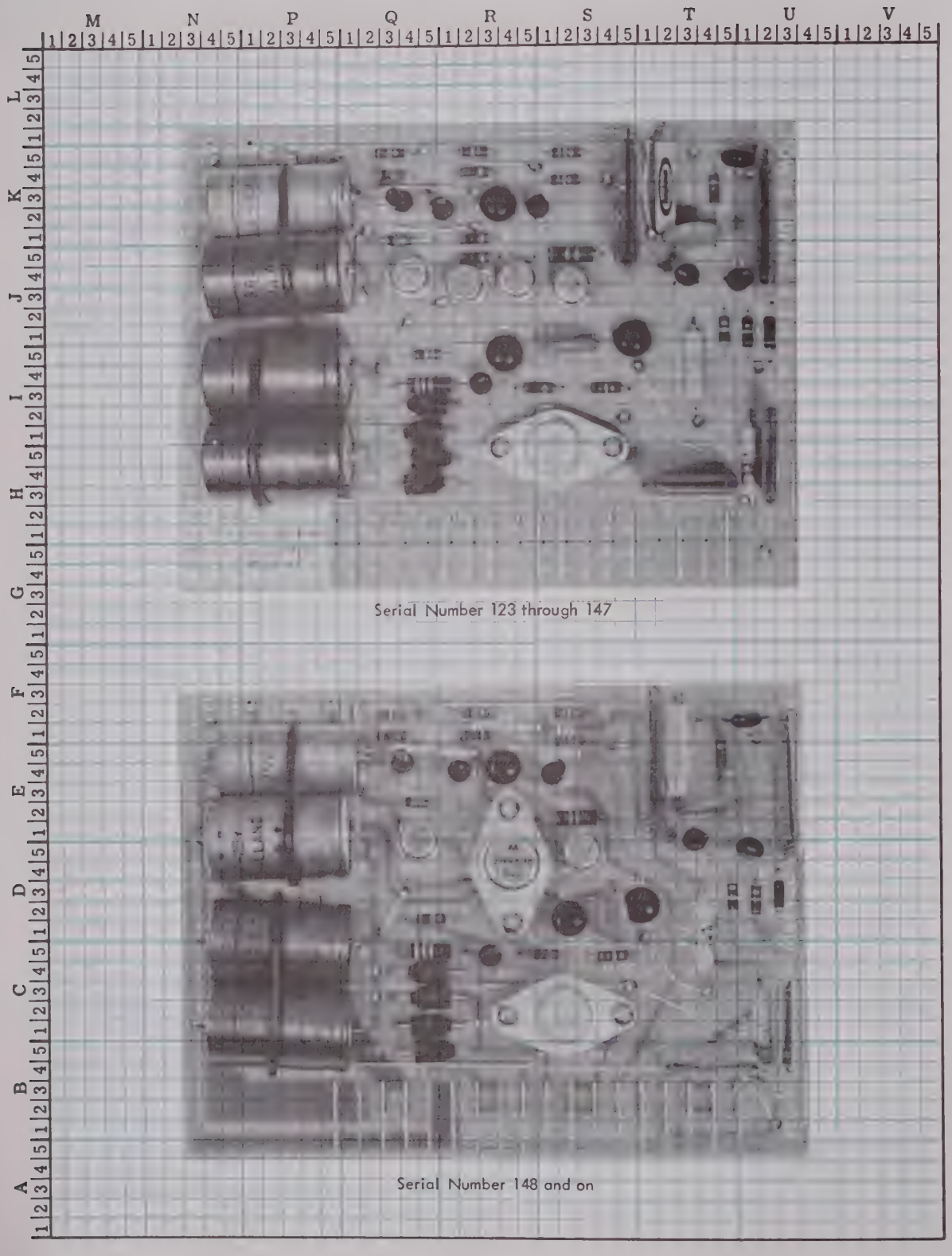


Figure 5-3. POWER SUPPLY "B" P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R2	E2-S2	Res, comp, 1Ω ±5%, 1/2w	4704-218693	01121	EB10G5	1		
R3	J5-R2	Res, comp, 10Ω ±5%, 1/4w	4704-147868	01121	CB1005	2		A
R4	K1-R2	Res, comp, 10Ω ±5%, 1/4w	4704-147868	01121	CB1005	REF		A
R5	F2-Q3	Res, comp, 150k ±5%, 1/4w	4704-182212	01121	CB1545	1		
R6	D2-Q5	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	1		
R7	C5-Q5	Res, comp, 2.4Ω ±5%, 1/2w	4704-221713	01121	EB24G5	1		
R8	C5-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	1		
R9	F2-R2	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	1		
R10	F1-Q3	Res, comp, 3k ±5%, 1/4w	4704-193508	01121	CB3025	1		
R11	C5-S4	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	1		
R12	F1-R2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	1		
R13	D1-T4	Res, met flm, 7.5k ±1%, 1/2w	4705-192161	75042	Type CEC-TO	1		
R14	C1-U2	Res, met flm, 6.81k ±1%, 1/2w	4705-162552	75042	Type CEC-TO	1		
R15	E5-T1	Res, ww, 20k ±0.1%, 1w	4707-131680	89536	4707-131680	1		
R16	E5-T2	Res, var, ww, 2k ±10%, 1w	4702-190355	02660	3800P-202	1		
R17	E3-U3	Res, ww, 14.2k ±1%, 1w	4707-235465	89536	4707-235465	1		
R18	F1-S2	Res, comp, 56k ±5%, 1/4w	4704-170738	01121	CB5635	2		
R19	D3-T5	Res, comp, 30k ±5%, 1/4w	4704-193417	01121	CB3035	1		
R20	F2-S2	Res, comp, 56k ±5%, 1/4w	4704-170738	01121	CB5635	REF		
R21	E5-T5	Res, comp, 820Ω ±5%, 1/4w	4704-148015	01121	CB8215	1		
R22	D3-U1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	1		
R23	C1-U3	Res, ww, matched	1					
R24	B4-T5	Res, ww, matched	1					
		Transipad, nylon	3155-152207	17069	88000	5		

1 CR5, R23 and R24 are a factory matched set. For replacement, replace the entire Zener Resistor Set, part number 4807-228189.

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the Model 9500A, serial numbers 123 thru 262 and 273 thru 343 only. For replacement of this assembly, order the new dual in line assembly, 9500A-4025, part number 1702-239913. These two assemblies are electrically and mechanically interchangeable.						
A5		**RANGE LOGIC P/C ASSEMBLY** **Figure 5-4**	1702-226563 (9500A-4005)	89536	1702-226563	REF		C
A1	I3-T3	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	6	1	
A2	I3-U2	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A3	I3-U5	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A4	J3-U2	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	4	1	
A5	G2-U5	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A6	G4-T5	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A7	F1-T3	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A8	F1-U1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A9	F1-U5	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A10	D2-T2	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
C1	J2-S4	Cap, Ta, 3.3 uf ±10%, 15v	1508-182808	05397	K3R3C15K	1		
C2	H1-T4	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	4		
C3	G1-T5	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C4	H2-U2	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C5	H1-U2	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C6	I4-R2	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	2		
C7	C3-T4	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	5		
C8	C2-T4	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C9	C1-T4	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C10	B2-T4	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C11	B1-T4	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C12	H5-U3	Cap, mica, 430 pf ±5%, 500v	1504-177980	88419	CD15F431J	1		
C13	E4-T4	Cap, mica, 330 pf ±5%, 500v	1504-148445	88419	CD15F331J	1		
C14	F5-T5	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
CR1	D2-V1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	24	4	
CR2	C4-U5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR3	C2-V1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR4	B3-U5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR5	B2-V1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR6	D2-U3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR7	C1-U3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR8	B2-U4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR9	C4-U3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR10	B3-U3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR11	B4-U2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR12	B2-U2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR13	D2-U2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR14	C4-U2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR15	C2-U2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR16	C4-U4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR17	C2-U5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR18	B3-U4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR19	B2-U5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR20	D2-U5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR21	G4-N5	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	1	1	A
CR23	C1-R5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR24	C2-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR25	C3-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR26	C3-R5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
L1	I3-R3	Ferrite bead	2503-219535	02214	56-060-85-3B	1		
P1	E3-R3	Connector, 32 contact	2816-234930	91662	02-032-013-5-200	1		
Q1	E5-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	12	2	
Q2	I3-S3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q3	J3-S3	Tstr, unijunction	4805-186312	03508	2N2646	1	1	

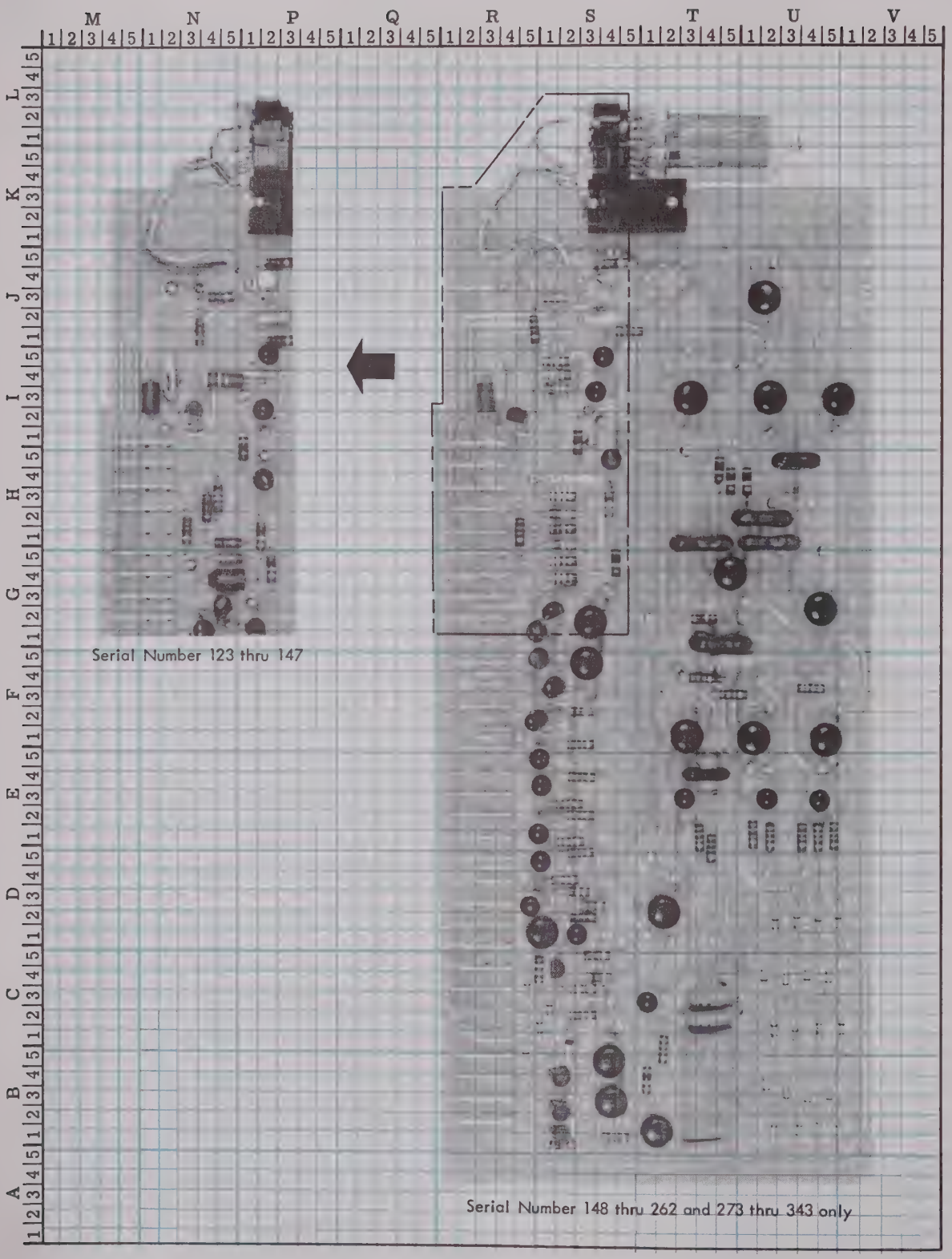


Figure 5-4. RANGE LOGIC P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q4	I5-S4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q5	E3-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q6	E3-U2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q7	E3-U5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q8	E4-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q9	E1-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q10	D5-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q11	G2-S3	Tstr, silicon, PNP	4805-169375	04713	MPS3638	6	1	
Q12	F5-S3	Tstr, silicon, PNP	4805-169375	04713	MPS3638	REF		
Q13	G2-S1	Tstr, silicon, NPN	4805-218503	03508	2N3877A	6	1	
Q14	G1-S1	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q15	F5-S1	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q16	F4-S1	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q17	F2-R5	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q18	H5-S4	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q19	C3-T1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q20	B1-T2	Tstr, silicon, PNP	4805-169375	04713	MPS3638	REF		
Q21	B3-S4	Tstr, silicon, PNP	4805-169375	04713	MPS3638	REF		
Q22	B5-S4	Tstr, silicon, PNP	4805-169375	04713	MPS3638	REF		
Q23	B1-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	6	1	
Q24	B2-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q25	B4-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q26	B5-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q27	C4-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q28	D1-S3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q29	D1-S1	Tstr, silicon, PNP	4805-169375	04713	MPS3638	REF		
Q30	D3-R5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q31	I2-R4	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
R1	F1-S3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	23		
R2	I4-N5	Res, comp, factory selected	2					A
R2	I3-S1	Res, comp, 150k ±5%, 1/4w 3	4704-182212	01121	CB1545	3		B

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R3	I4-S1	Res, comp, 390k ±5%, 1/4w 3	4704-193383	01121	CB3945	1		B
R4	I5-S1	Res, comp, 330k ±5%, 1/4w 3	4704-192948	01121	CB3345	3		B
R5	J3-S1	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	1		
R6	J5-S4	Res, comp, 22Ω ±5%, 1/4w	4704-147884	01121	CB2205	1		
R7	E1-U5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R8	F4-T4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R9	E1-T4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R10	F3-T5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R11	E1-U1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R12	F4-U4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R13	E1-U4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R14	E1-T4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R15	E1-U2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R16	E1-U4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R17	H5-T4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	9		
R18	G2-T4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R19	H4-T5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R20	H4-U1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R21	E3-S2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R22	E1-S2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R23	D4-S2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R24	E4-S3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R25	E2-S3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R26	D5-S3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R27	F2-S3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	2		
R28	H2-N4	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	2		A
R28	H3-S2	Res, comp, 470k ±5%, 1/4w	4704-188441	01121	CB4745	1		B
R29	G4-S2	Res, comp, 330k ±5%, 1/4w	4704-192948	01121	CB3345	REF		
R30	H1-P1	Res, comp, 82k ±5%, 1/4w	4704-188458	01121	CB8235	1		A
R30	H3-S4	Res, comp, 150k ±5%, 1/4w	4704-182212	01121	CB1545	REF		B
R31	G5-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R32	H1-N5	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R32	G5-S2	Res, comp, 330k ±5%, 1/4w	4704-192948	01121	CB3345	REF		B
R33	B4-T1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R34	C1-T2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R35	B1-S4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R36	B1-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R37	C4-S4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R38	C5-S4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R39	D3-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R40	D2-S3	Res, comp, 5.6k ±5%, 1/4w	4704-148080	01121	CB5625	1		
R41	C4-S1	Res, comp, 68k ±5%, 1/4w	4704-148171	01121	CB6835	1		
R42	D3-S4	Res, comp, 7.5k ±5%, 1/4w	4704-193326	01121	CB7525	1		
R43	H3-N4	Res, comp, 24k ±5%, 1/4w	4704-193425	01121	CB2435	1		A
R43	H1-S2	Res, comp, 16k ±5%, 1/4w	4704-221606	01121	CB1635	1		B
R44	J1-S5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R45	H1-R5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R46	J2-R5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R47	C3-S3	Res, comp, 1.3k ±5%, 1/4w	4704-234252	01121	CB1325	1		
R48	C2-S3	Res, comp, 1.5k ±5%, 1/4w	4704-148031	01121	CB1525	1		
R49	I1-S2	Res, comp, 47Ω ±5%, 1/4w	4704-147892	01121	CB4705	1		
R50	H2-S2	Res, comp, 220k ±5%, 1/4w	4704-160937	01121	CB2245	1		B
R51	H1-S2	Res, comp, 150k ±5%, 1/4w	4704-182212	01121	CB1545	REF		B
V1	L1-T4	Tube, readout, 0-9 Nixie	5700-218875	83594	B-5441	1	1	
XV1	L1-S4	Socket, tube	2112-220350	83594	SK-199	1		
		Transipad, nylon	3155-152207	17069	88000	6		

2 For serial numbers 123 thru 147, R2 was factory selected. For replacement, replace with exact value.

3 R2, R3 or R4 may not be installed for serial numbers 148 and on.

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the Model 9500A, serial numbers 263 thru 272 and 344 and on. This assembly replaces the old micrologic assembly 9500A-4005, part number 1702-226563.						
A5		**RANGE LOGIC P/C ASSEMBLY** **Figure 5-5**	1702-239913 (9500A-4025)	89536	1702-239913	REF		D
A1	J1-S5	IC, RTL, Hex Inverter	3130-245241	04713	MC889P	1	1	
A2	B4-S5	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	2	1	
A3	E4-S5	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	3	1	
A4	G1-S5	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A5	D1-S5	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A6	H4-S5	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	REF		
A7	D1-R1	IC, DTL, Dual 4-Input Gate Expander	3130-245282	04713	MC833P	3	1	
A8	E1-R1	IC, DTL, Dual 4-Input Gate Expander	3130-245282	04713	MC833P	REF		
A9	F1-R1	IC, DTL, Dual 4-Input Gate Expander	3130-245282	04713	MC833P	REF		
C1	H1-R1	Cap, Ta, 3.3 uf ±10%, 15v	1508-182808	05397	K3R3C15K	1		
C2	E2-S1	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	4		
C3	E4-S2	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C4	D5-S2	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C5	D3-S2	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C6	E5-Q4	Cap, cer, 0.1 uf +80/-20%, 500v	1501-105668	56289	29C9B5	5		
C7	D5-Q3	Cap, cer, 0.1 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C8	E3-Q3	Cap, cer, 0.1 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C9	D3-Q3	Cap, cer, 0.1 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C10	C5-Q3	Cap, cer, 0.1 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C11	C4-S5	Cap, mica, 330 pf ±5%, 500v	1504-148445	88419	CD15F331J	1		
C12	I5-P4	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
CR2	C2-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	4	1	
CR3	C3-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR4	C3-Q5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR5	C4-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
L1	I5-P5	Ferrite bead	2503-219535	02214	56-060-85-3B	1		
P1	H1-P5	Connector, 32 contact	2816-234930	91662	02-032-013-5-200	1		
Q1	J4-R4	Tstr, high voltage, NPN	4805-245480	03877	ST81011	6	1	
Q2	J3-R3	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q3	I5-R3	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q4	I4-R5	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q5	G5-S3	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q6	J5-Q3	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q7	B1-R2	Tstr, silicon, NPN	4805-159855	07910	CS23030	10	2	
Q8	A5-Q4	Tstr, silicon, PNP	4805-169375	04713	MPS3638	3	1	
Q9	B4-R2	Tstr, silicon, PNP	4805-169375	04713	MPS3638	REF		
Q10	C1-Q5	Tstr, silicon, PNP	4805-169375	04713	MPS3638	REF		
Q11	B3-Q2	Tstr, silicon, NPN	4805-168708	03508	2N3391	4	1	
Q12	B3-Q4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q13	C1-Q3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q14	C1-R2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q15	A5-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q16	A5-S3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q17	A5-R4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q18	G4-R3	Tstr, silicon, NPN	4805-218396	04713	2N3904	1	1	
Q19	I2-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q20	H4-R1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q21	H5-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q22	F4-Q5	Tstr, unijunction	4805-186312	03508	2N2646	1	1	
Q23	C4-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q24	C4-S3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q25	G3-S3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
R1	G5-T1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	3		
R3	J2-Q4	Res, comp, 220k ±5%, 1/2w	4704-109025	01121	EB2245	1		
R5	J2-Q3	Res, comp, 150k ±5%, 1/4w	4704-182212	01121	CB1545	2		

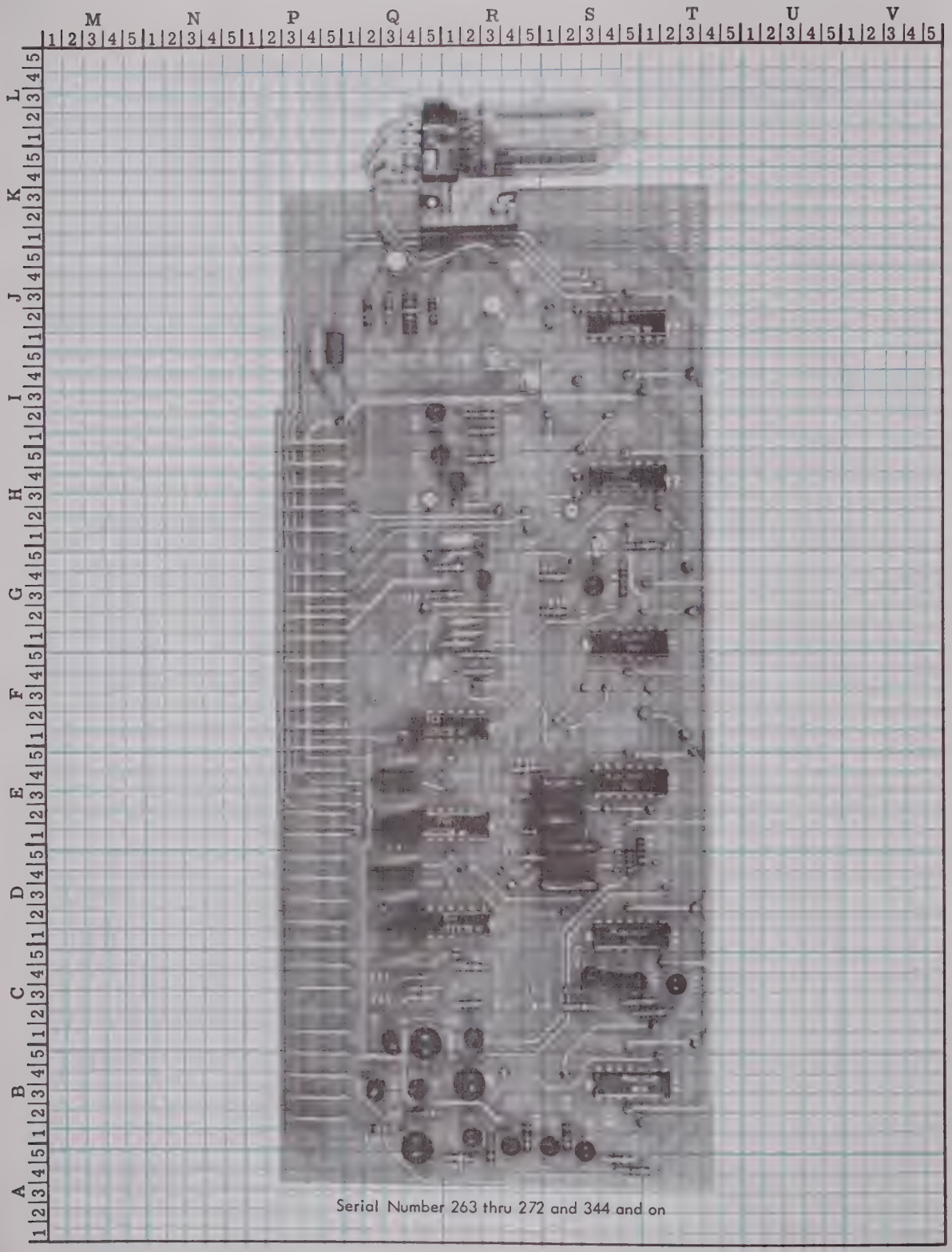


Figure 5-5. RANGE LOGIC P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R6	J2-Q2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	7		
R7	A5-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R8	A5-R3	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	16		
R9	B2-Q5	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R10	B1-Q2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R11	C4-R2	Res, comp, 1. 3k ±5%, 1/4w	4704-234252	01121	CB1325	1		
R12	C2-R2	Res, comp, 1. 5k ±5%, 1/4w	4704-148031	01121	CB1525	1		
R13	A4-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R14	B1-S2	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	2		
R15	B1-R5	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	REF		
R16	A5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R17	G4-R1	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R18	F5-R2	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R19	G1-R1	Res, comp, 150k ±5%, 1/4w ▷4	4704-182212	01121	CB1545	REF		
R20	F4-R2	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	1		
R21	I1-R2	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R22	H5-R2	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R23	G3-R1	Res, comp, 22Ω ±5%, 1/4w	4704-147884	01121	CB2205	1		
R24	E3-R5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R25	E4-R5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R26	E1-R5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R27	D5-R5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R28	C2-T1	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R29	C2-S2	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R30	G2-S1	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R31	I2-R2	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R32	D5-T1	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R33	C3-T1	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R34	D5-S5	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R35	C3-S2	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R36	G4-S5	Res, comp, 2. 2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R37	G4-S1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R38	J2-Q5	Res, comp, 20k ±5%, 1/4w	4704-221614	01121	CB2035	1		
R39	G2-R2	Res, comp, 390k ±5%, 1/4w 4	4704-193383	01121	CB3945	1		
R40	G1-R2	Res, comp, 330k ±5%, 1/4w 4	4704-192948	01121	CB3345	1		
V1	L1-S1	Tube, readout, 0-9 Nixie	5700-218875	83594	B-5441	1		
XV1	L1-R1	Socket, tube	2112-220350	83594	SK-199	1		
		Transipad, nylon	3155-152207	17069	88000	9		

4 R19, R39 or R40 may not be installed.

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the model 9500A, serial numbers 123 thru 262 and 273 thru 343 only. For replacement of this assembly, order the new dual in line assembly, 9500A-4026, part number 1702-239921. These two assemblies are electrically and mechanically interchangeable.						
A6		**0-11 COUNTER P/C ASSEMBLY Figure 5-6**	1702-226571 (9500A-4006)	89536	1702-226571	REF		C
A1	E5-S1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	9	2	
A2	H2-Q4	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A3	H2-R4	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A4	H2-S2	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A5	H2-T2	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A6	C4-R1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A7	C4-R5	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A8	C4-S3	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A9	C4-T2	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A10	F1-R1	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	5	1	
A11	B1-Q5	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A12	B1-R4	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A13	B1-S3	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A14	F1-T1	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
C1	E3-R1	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	6		
C2	E4-Q5	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C3	F3-R3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C4	E4-R3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C5	E3-S4	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C6	E5-S4	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C7	I1-Q2	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
CR1	G5-Q5	Diode, silicon, 150 ma	4802-203523	03508	DHD1105	15	2	
CR2	J1-S2	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	4	1	
CR3	J1-R5	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
CR4	I5-R4	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	REF		
CR5	B1-T1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR6	B1-T2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR7	J1-S3	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	REF		
CR8	G2-Q5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR9	G2-R2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR10	G5-S5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR11	G3-Q5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR12	G4-Q5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR13	G4-R2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR14	G4-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR15	G3-S5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR16	I1-S2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR17	I1-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR18	F3-S2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR19	F3-S2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
L1	I2-Q2	Ferrite bead	2503-219535	02214	56-060-85-3B	1		
P1	D5-P4	Connector, 27 contact	2816-234922	91662	02-027-013-5-200	1		
Q1	D5-T1	Tstr, silicon, NPN	4805-159855	07910	CS23030	11	2	
Q2	F4-Q4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q3	D2-Q4	Tstr, silicon, NPN	4805-218396	04713	2N3904	4	1	
Q4	D2-R3	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q5	D2-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q6	D2-T1	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q7	I2-R3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q8	G1-R4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q9	G1-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q10	G1-S2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q11	C1-Q4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q12	B5-R2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q13	C1-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q14	C1-S5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q15	B3-S5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q16	B1-Q2	Tstr, silicon, PNP	4805-169375	04713	MPS3638	2	1	
Q17	B3-Q2	Tstr, silicon, PNP	4805-169375	04713	MPS3638	REF		
Q18	J5-S4	Tstr, silicon, NPN	4805-218503	03508	2N3877A	12	2	
Q19	J3-S5	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q20	J5-Q3	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q21	J3-Q5	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q22	J5-R3	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q23	J3-R4	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q24	J5-Q5	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q25	J3-R2	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q26	J5-Q1	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q27	J3-Q2	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q28	J5-S2	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q29	J4-R5	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
R5	F5-Q5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	13		
R10	D4-C5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R11	D4-R4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R12	D4-S3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R13	D3-T1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R14	E1-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	6		
R15	E1-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R16	F2-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R17	E1-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R18	E2-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R19	E2-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R20	I1-S4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R21	I1-S3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R22	I1-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		

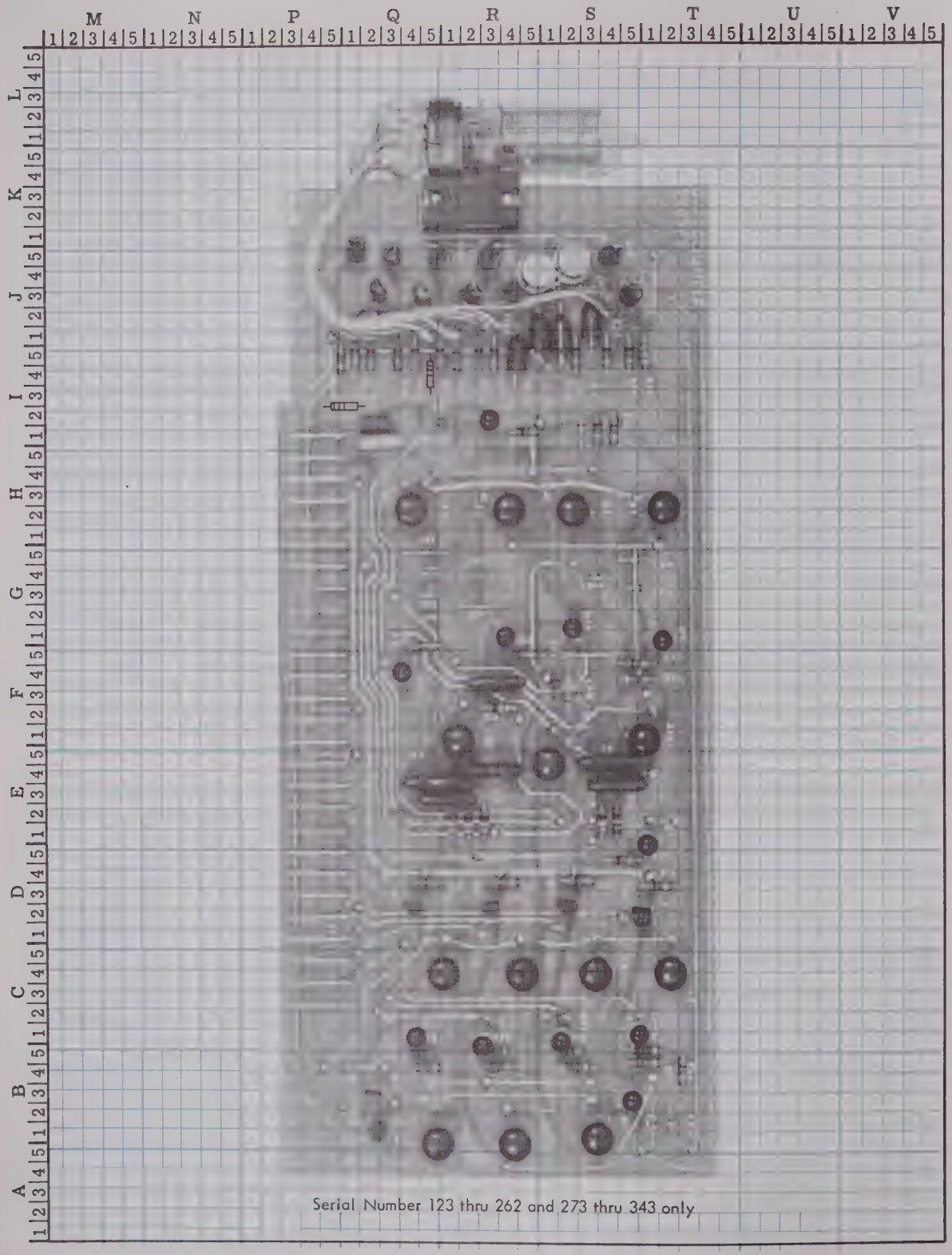


Figure 5-6. 0-11 COUNTER P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R23	F3-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R24	F5-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R25	F5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R26	F4-S5	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	2		
R27	I2-R1	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R28	B5-Q5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	8		
R29	B5-R4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R30	B5-S2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R31	B5-T1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R32	B4-Q5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R33	B4-R4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R34	B4-S2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R35	B5-T1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R36	B4-T3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R37	I5-S4	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	12		A
R37	I5-S4	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	10		B
R38	I5-S5	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R38	I5-S5	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R39	I5-Q3	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R39	I5-Q3	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R40	I5-Q4	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R40	I5-Q4	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R41	I5-R2	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R41	I5-R2	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R42	I5-R3	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R42	I5-R3	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R43	I5-Q5	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R43	I5-Q5	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R44	I5-R1	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R44	I5-R1	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R45	I5-Q1	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R45	I5-Q1	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R46	I5-Q2	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R46	I5-Q2	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R47	I5-S2	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R48	I5-P5	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R48	I5-P5	Res, comp, 470k ±5%, 1/4w	4704-188441	01121	CB4745	1		B
R49	I5-T1	Res, comp, 24k ±5%, 1/4w	4704-193425	01121	CB2435	1		A
R49	I5-T1	Res, comp, 16k ±5%, 1/4w	4704-221606	01121	CB1635	1		B
R50	D5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R51	I4-Q5	Res, comp, 220k ±5%, 1/4w	4704-160937	01121	CB2245	1		B
R52	I2-Q1	Res, comp, 120k ±5%, 1/4w	4704-193458	01121	CB1245	1		B
V1	L1-S1	Tube, readout, 0-9 Nixie	5700-218875	83594	B-5441	1		
XV1	L1-R1	Socket, tube	2112-220350	83594	SK-199	1		
		Transipad, nylon	3155-152207	17069	88000	2		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the model 9500A, serial numbers 263 thru 272 and 344 and on. This assembly replaces the old micrologic assembly 9500A-4006, part number 1702-226571.						
A6		**0-11 COUNTER P/C ASSEMBLY Figure 5-7**	1702-239921 (9500A-4026)	89536	1702-239921	REF		D
A1	B2-T2	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	4	1	
A2	B2-R2	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A3	E3-R2	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	3	1	
A4	C3-R2	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	REF		
A5	E3-T2	IC, RTL, Dual 4-Input Gate	3130-245274	04713	MC819P	1	1	
A6	C3-T2	IC, RTL, JK Flip Flop	3130-245266	04713	MC816P	1	1	
A7	G4-T2	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A8	G4-R2	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A9	I1-T2	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	REF		
A10	I1-R2	IC, RTL, Hex Inverter	3130-245241	04713	MC889P	1	1	
C1	I2-Q2	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
C2	E2-S4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	6		
C3	E4-S4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C4	D3-S4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C5	D5-S4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C6	F4-S1	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C7	F1-S1	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
L1	I1-Q3	Ferrite bead	2503-219535	02214	56-060-85-3B	1		
P1	H1-P4	Connector, 27 contact	2816-234922	91662	02-027-013-5-200	1		
Q1	D4-R2	Tstr, silicon, NPN	4805-159855	07910	CS23030	6	1	
Q2	D1-S2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q3	B4-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	4	1	
Q4	B2-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q5	A5-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q6	C1-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		

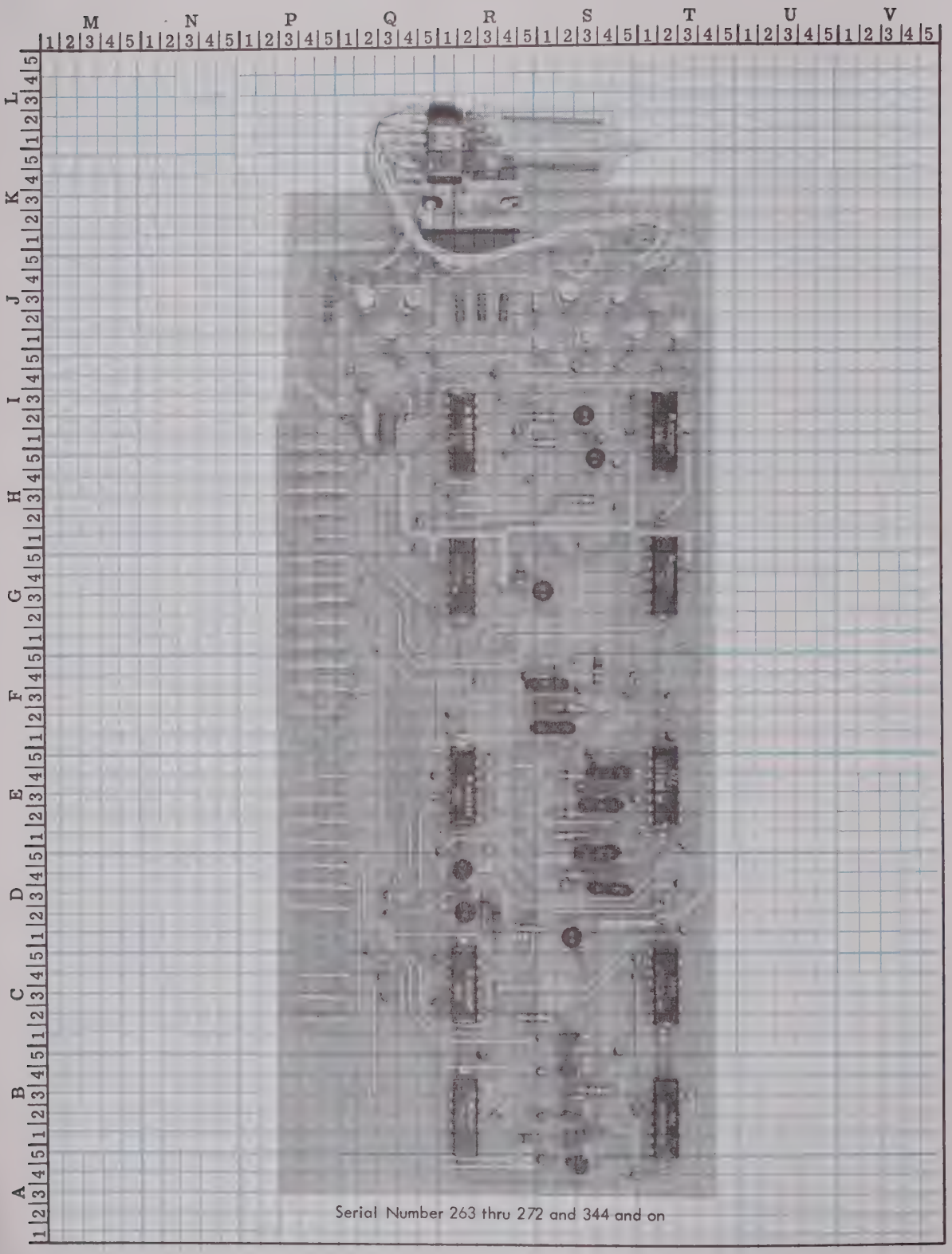


Figure 5-7. 0-11 COUNTER P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q7	D2-R2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q8	G3-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q9	H5-S3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q10	J1-Q5	Tstr, high voltage, NPN	4805-245480	03877	ST81011	11	2	
Q11	J3-Q4	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q12	J1-S3	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q13	J3-S2	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q14	J1-T3	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q15	J3-T1	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q16	J1-S5	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q17	J3-S5	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q18	J1-Q3	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q19	J3-Q2	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q20	J1-S1	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q22	I2-S3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
R1	J3-P5	Res, comp, 20k ±5%, 1/4w	4704-221614	01121	CB2035	1		
R2	J3-R2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	2		
R3	J3-R3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R4	J3-R4	Res, comp, 5.6k ±5%, 1/4w	4704-148080	01121	CB5625	1		
R13	I1-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	10		
R14	I2-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R15	H3-S3	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	1		
R16	G4-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R17	B3-S3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R18	B1-S3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R19	B1-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R20	C2-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R21	E2-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	6		
R22	E4-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R23	D4-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R24	E1-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R25	F4-S3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R26	F2-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R27	D2-R3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R28	D1-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R29	D2-R3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
V1	L1-S1	Tube, readout, 0-9 Nixie	5700-218875	83594	B-5441	1		
XV1	L1-R1	Socket, tube	2112-220350	83594	SK-199	1		
		Transipad, nylon	3155-152207	17069	88000	11		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the Model 9500A, serial numbers 123 thru 262 and 273 thru 343 only. For replacement of this assembly, order the new dual in line assembly, 9500A-4027, part number 1702-239939. These two assemblies are electrically and mechanically interchangeable.						
A7, A8, A9		**0-9 COUNTER P/C ASSEMBLY Figure 5-8**	1702-226589 (9500A-4007)	89536	1702-226589	REF		C
A1	F3-R5	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	9	1	
A2	H3-Q4	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A3	H3-R4	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A4	H3-S2	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A5	H3-T1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A6	C4-Q5	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A7	C4-R4	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A8	C4-S3	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A9	C4-T2	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A10	F3-R1	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	5	1	
A11	B1-R1	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A12	B1-S1	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A13	B1-S5	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A14	F3-S5	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
C1	F2-Q4	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	6		
C2	E5-Q5	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C3	F1-R3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C4	G1-R3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C5	F1-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C6	F1-S5	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C7	I1-Q3	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
CR1	G4-Q5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	13	2	
CR2	H1-Q5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR3	G5-S5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		

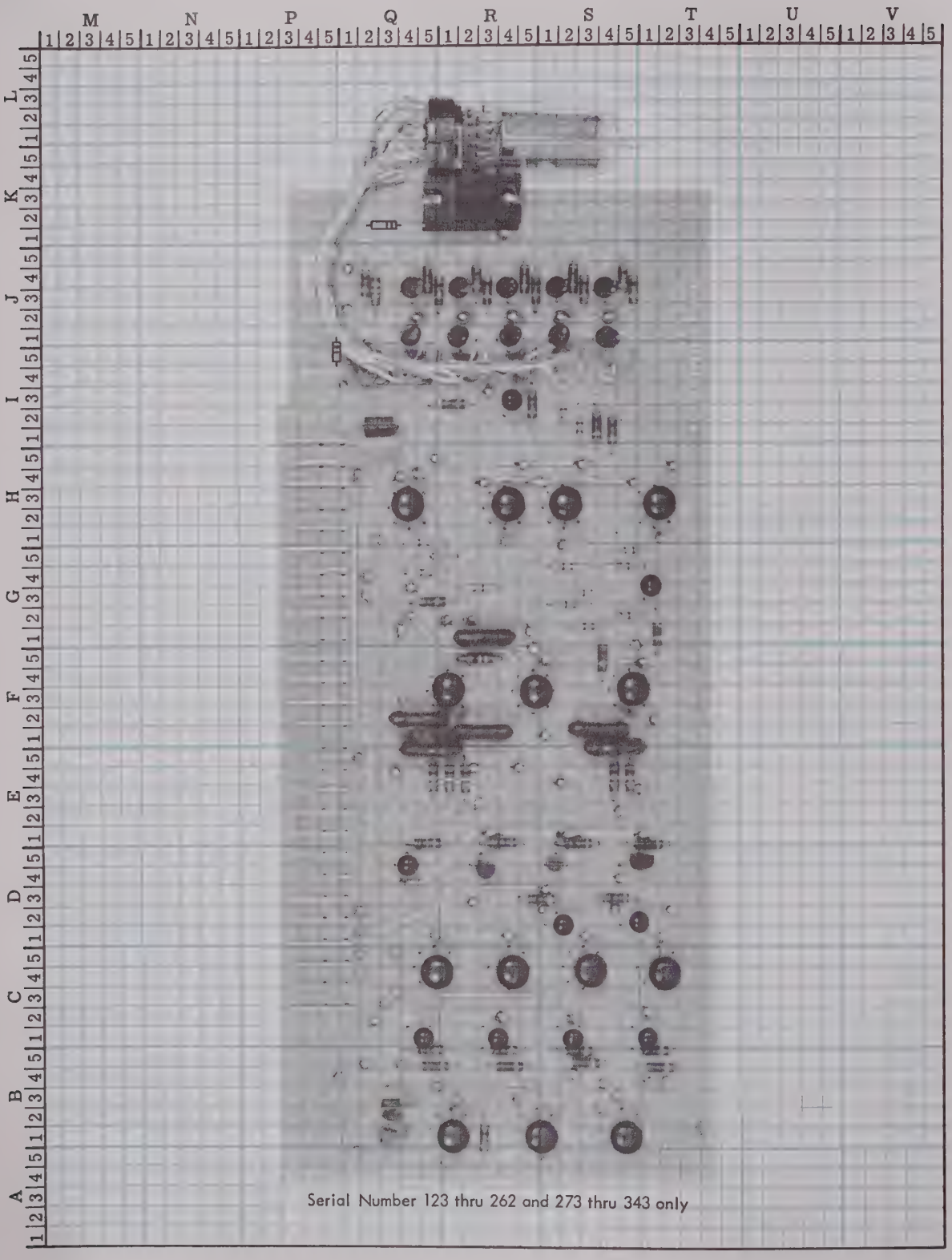


Figure 5-8. 0-9 COUNTER P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
CR4	I2-S2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR5	I1-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR6	G3-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR7	G5-Q5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR8	G3-R3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR9	G5-S2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR10	G5-S5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR11	G2-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR12	G3-S2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR13	G2-S5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
L1	I2-Q2	Ferrite bead	2503-219535	02214	56-060-85-3B	1		
P1	H5-P5	Connector, 27 contact	2816-234922	91662	02-027-013-5-200	1		
Q1	I3-R4	Tstr, silicon, NPN	4805-159855	07910	CS23030	9	1	
Q2	G4-T1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q3	D5-Q4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q4	D4-R3	Tstr, silicon, NPN	4805-218396	04713	2N3904	3	1	
Q5	D5-S1	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q6	D5-T1	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q7	C1-T1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q8	C1-S2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q9	C1-R3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q10	C1-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q11	B3-Q3	Tstr, silicon, PNP	4805-169375	04713	MPS3638	2	1	
Q12	B1-Q3	Tstr, silicon, PNP	4805-169375	04713	MPS3638	REF		
Q13	J4-Q4	Tstr, silicon, NPN	4805-218503	03508	2N3877A	10	2	
Q14	J1-Q4	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q15	J4-S1	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q16	J1-S2	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q17	J4-R2	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q18	J1-R1	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q19	J4-S4	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q20	J1-S4	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q21	J4-R4	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q22	J1-R4	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q23	D2-S2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q24	D2-T1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
R1	I1-S4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	10		
R2	I2-S3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R3	I3-R1	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	2		
R4	I3-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R5	G1-T1	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R6	F5-S4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R7	G3-Q5	Res, comp, 1.5k ±5%, 1/4w	4704-148031	01121	CB1525	1		
R8	E4-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	6		
R9	E4-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R10	E4-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R11	F5-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R12	E4-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R13	E4-Q5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R14	E1-Q5	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	1		
R17	E1-R4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R19	E1-S2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R21	E1-T1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R22	B5-T1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	8		
R23	B5-T1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R24	B5-S3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R25	B5-S3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R26	B5-R4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R27	B5-R4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R28	B5-Q5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R29	B5-Q5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R30	J4-Q5	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	11		A
R30	J4-Q5	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	10		B
R31	J3-R1	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R31	J3-R1	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R32	J4-S2	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R32	J4-S2	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R33	J3-S3	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R33	J3-S3	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R34	J4-R2	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R34	J4-R2	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R35	J4-R3	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R35	J4-R3	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R36	J4-S5	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R36	J4-S5	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R37	J3-S5	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R37	J3-S5	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R38	J4-R5	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R38	J4-R5	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R39	J3-R5	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R39	J3-R5	Res, comp, 51k ±5%, 1/4w	4704-193334	01121	CB5135	REF		B
R40	J4-Q2	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	REF		A
R40	J4-Q2	Res, comp, 470k ±5%, 1/4w	4704-188441	01121	CB4745	1		B
R41	J3-Q2	Res, comp, 24k ±5%, 1/4w	4704-193425	01121	CB2435	1		A
R41	J3-Q2	Res, comp, 16k ±5%, 1/4w	4704-221606	01121	CB1635	1		B
R42	B1-R3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R43	D3-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R44	D3-S4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R45	I5-P5	Res, comp, 220k ±5%, 1/4w	4704-160937	01121	CB2245	1		B
R46	K2-Q3	Res, comp, 120k ±5%, 1/4w	4704-193458	01121	CB1245	1		B
V1	L1-S1	Tube, readout, 0-9 Nixie	5700-218875	83594	B-5441	1		
XV1	L1-R1	Socket, tube Transipad, nylon	2112-220350 3155-152207	83594 17069	SK-199 88000	1 2		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the Model 9500A, serial numbers 263 thru 272 and 344 and on. This assembly replaces the old micrologic assembly 9500A-4007, part number 1702-226589.						
A7, A8, A9		**0-9 COUNTER P/C ASSEMBLY** **Figure 5-9**	1702-239939 (9500A-4027)	89536	1702-239939	REF		D
A1	B3-T2	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	4	1	
A2	B3-R2	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A3	E4-R2	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	3	1	
A4	C4-R2	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	REF		
A5	E4-T2	IC, RTL, Dual 4-Input Gate	3130-245274	04713	MC819P	1	1	
A6	C4-T2	IC, RTL, JK Flip Flop	3130-245266	04713	MC816P	1	1	
A7	G4-T2	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A8	G4-R1	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A9	I1-T1	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	REF		
A10	I1-R1	IC, RTL, Hex Inverter	3130-245241	04713	MC889P	1	1	
C1	I4-Q2	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
C2	E3-S4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	6		
C3	E5-S4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C4	D4-S4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C5	E1-S3	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C6	F4-S1	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C7	F2-S1	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
L1	I2-Q2	Ferrite bead	2503-219535	02214	56-060-85-3B	1		
P1	G2-P4	Connector, 27 contact	2816-234922	91662	02-027-013-5-200	1		
Q1	D4-R2	Tstr, silicon, NPN	4805-159855	07910	CS23030	6	1	
Q2	D2-R2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q3	B4-S2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q4	C2-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	3	1	
Q5	B2-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q6	C1-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		

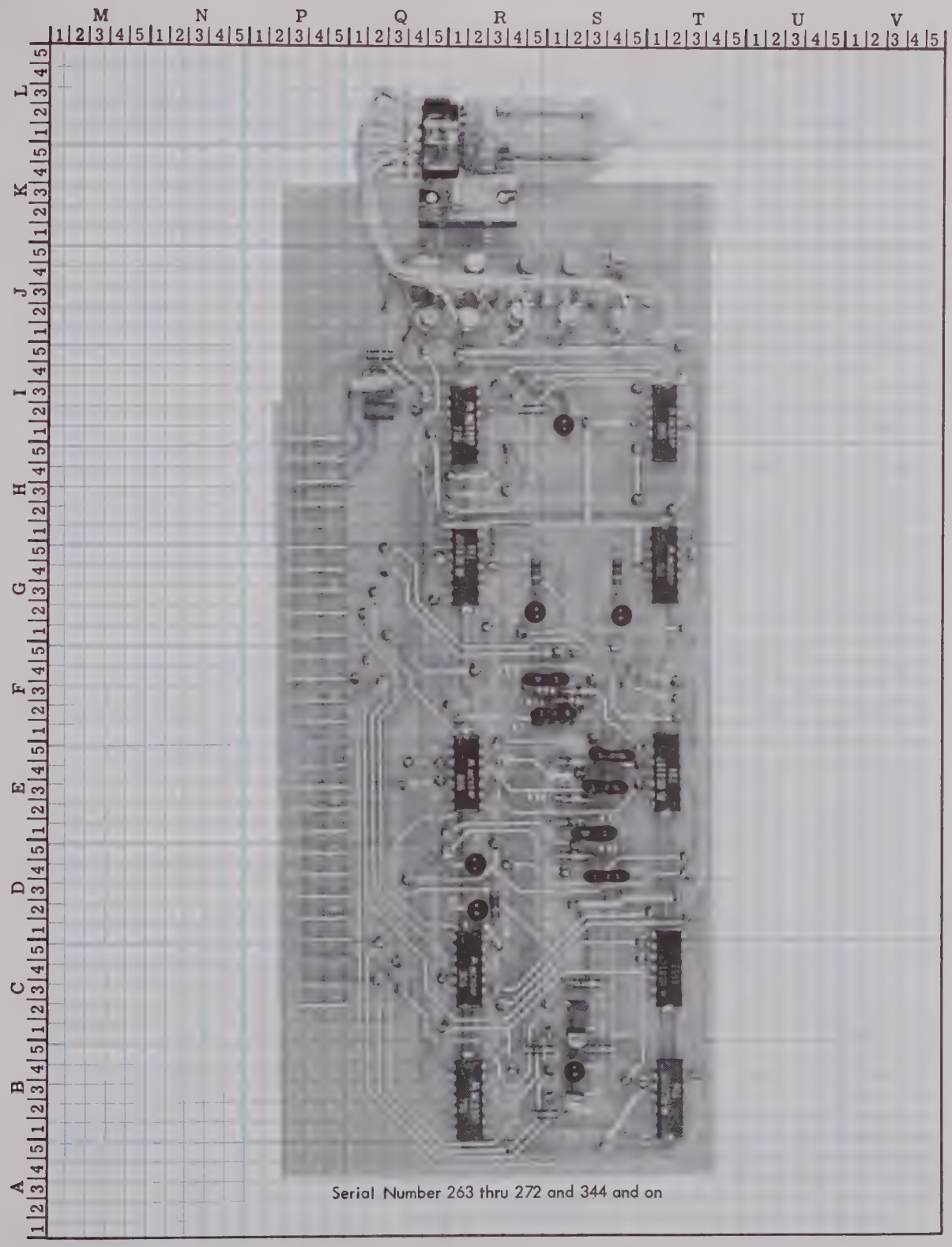


Figure 5-9. 0-9 COUNTER P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q7	G2-S4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q8	G2-R5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q9	I1-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q10	J2-R2	Tstr, high voltage, NPN	4805-245480	03877	ST81011	10	1	
Q11	J5-R2	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q12	J2-R4	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q13	J5-R5	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q14	J2-S4	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q15	J5-S4	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q16	J4-S2	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q17	J5-S2	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q18	J2-Q5	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q19	J5-Q4	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
R1	I5-Q2	Res, comp, 20k ±5%, 1/4w	4704-221614	01121	CB2035	1		
R13	I2-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	7		
R14	G4-S4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R15	G4-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R16	B5-S3	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	1		
R17	C3-S3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R18	B2-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R19	B5-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R20	E3-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	6		
R21	E4-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R22	D5-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R23	E1-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R24	F3-S3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R25	F2-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R26	D2-R3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
V1	L1-S1	Tube, readout, 0-9 Nixie	5700-218875	83594	B-5441	1		
XV1	L1-Q5	Socket, tube	2112-220350	83594	SK-199	1		
		Transipad, nylon	3155-152207	17069	88000	10		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the Model 9500A, serial numbers 123 thru 262 and 273 thru 343 only. For replacement of this assembly, order the new dual in line assembly, 9500A-4028, part number 1702-239947. These two assemblies are electrically and mechanically interchangeable.						
A10		**CONTROL LOGIC P/C ASSEMBLY** **Figure 5-10**	1702-226597 (9500A-4010)	89536	1702-226597	REF		C
A1	B2-R1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	7	1	
A2	C4-R1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A3	G2-R1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A4	E2-R1	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	6	1	
A5	B2-S3	IC, RTL, Flip Flop	3130-241430	07263	U5B997429X	1	1	
A6	I4-S2	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A7	D4-S3	IC, RTL, Buffer	3130-218495	07263	U8A990028	3	1	
A8	C4-S3	IC, RTL, Buffer	3130-218495	07263	U8A990028	REF		
A9	G2-S1	IC, RTL, Buffer	3130-218495	07263	U8A990028	REF		
A10	I4-R1	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A11	K1-S3	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A12	K1-R1	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A13	J1-T2	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A14	I1-T3	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A15	H2-T3	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A16	K3-T2	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A17	G3-T3	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
C1	B4-R1	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	6		
C2	C1-R1	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C3	D2-Q5	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C4	D1-Q5	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C5	J2-Q1	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
C6	I5-Q5	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C7	J1-R1	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		

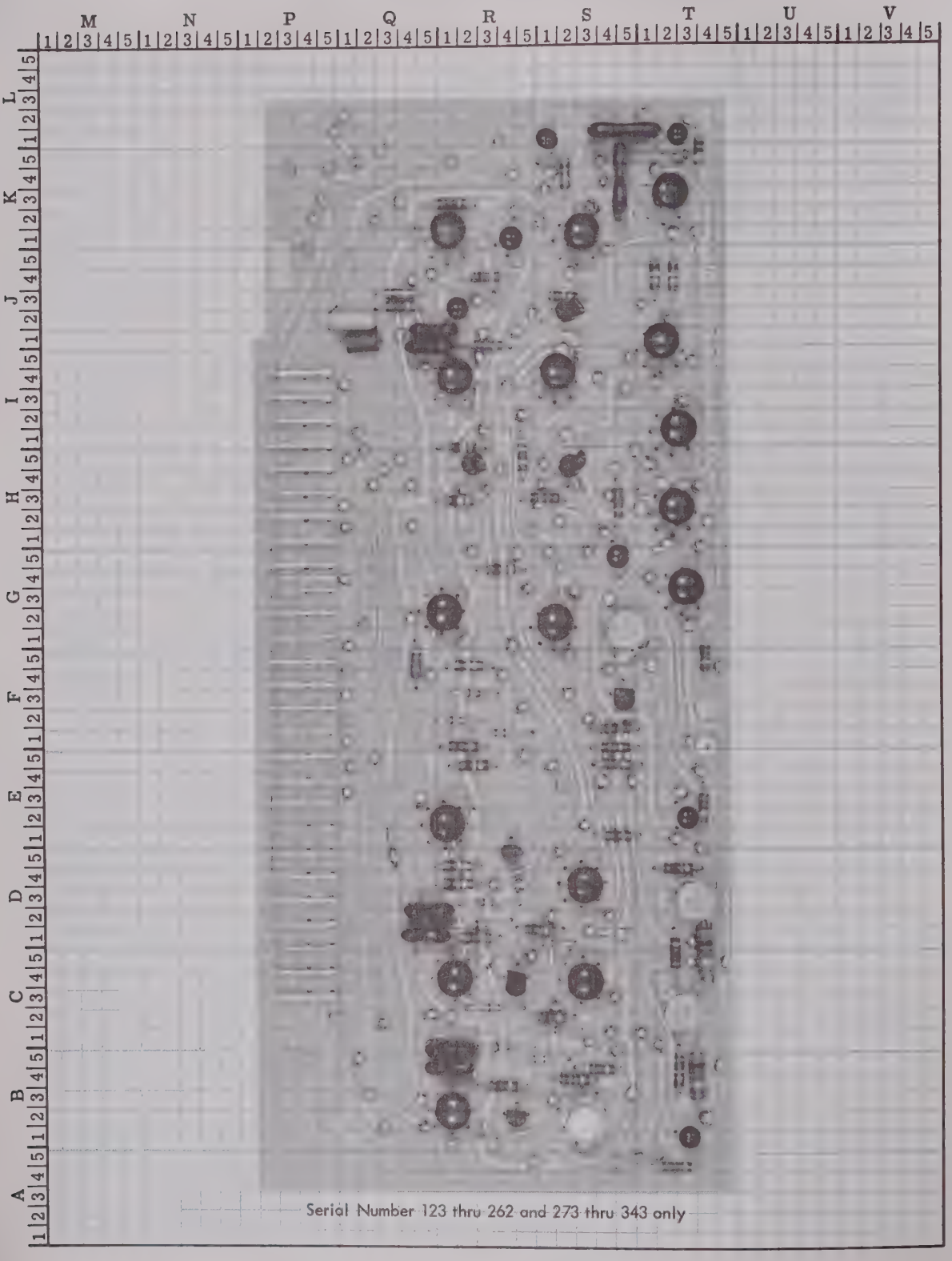


Figure 5-10. CONTROL LOGIC P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
C8	L1-S4	Cap, mica, 0.001 uf ±1%, 500v	1504-217844	88419	CD19F102F	2		
C9	K4-S5	Cap, mica, 0.001 uf ±1%, 500v	1504-217844	88419	CD19F102F	REF		
CR1	F1-R4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	10	2	
CR2	C1-R3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR3	D2-R3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR4	F2-R1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR5	D1-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR6	C2-R3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR7	D3-R3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR8	F3-R2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR9	B5-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR10	C1-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
L1	J1-Q2	Ferrite bead	2503-219535	02214	56-060-85-3B	1		
P1	H2-P4	Connector, 27 contact	2816-234922	91662	02-027-013-5-200	1		
Q1	B2-R4	Tstr, silicon, NPN	4805-218396	04713	2N3904	3	1	
Q2	C4-R4	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q3	D5-R4	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q4	K1-R4	Tstr, silicon, NPN	4805-159855	07910	CS23030	7	1	
Q5	B1-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q6	F3-S5	Tstr, silicon, PNP	4805-169375	04713	MPS3638	1	1	
Q7	H5-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	3	1	
Q8	H5-R2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q9	J2-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q10	J2-R1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q11	C2-T3	Tstr, germanium, PNP	4805-148643	01295	2N1307	3	1	
Q12	D3-T3	Tstr, germanium, PNP	4805-148643	01295	2N1307	REF		
Q13	G1-S5	Tstr, germanium, PNP	4805-148643	01295	2N1307	REF		
Q14	L1-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q15	E2-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q16	G5-S5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q17	L1-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
R1	B4-R4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	8		
R2	D1-R2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R3	F1-R2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R4	D5-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	9		
R5	F5-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R6	D4-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R7	E5-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R8	J3-Q3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R9	J4-R3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R10	K3-R1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	6		
R11	D1-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R12	C2-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R13	A5-T3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R14	B5-S4	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	1		
R15	E5-S4	Res, comp, 5.6k ±5%, 1/4w	4704-148080	01121	CB5625	1		
R16	F1-S4	Res, comp, 1.8k ±5%, 1/4w	4704-175042	01121	CB1825	1		
R17	H3-S1	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	1		
R18	H3-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R19	H5-R5	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	1		
R20	G4-R4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R21	H5-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R22	J3-S2	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	2		
R23	J3-Q4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R24	J1-R3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R25	B4-T3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R26	E5-S5	Res, comp, 750Ω ±5%, 1/4w	4704-218024	01121	CB7515	1		
R27	B4-T3	Res, comp, 1k ±5%, 1/2w	4704-108597	01121	EB1025	2		
R28	C5-T2	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	2		
R29	C5-T4	Res, comp, 1k ±5%, 1/2w	4704-108597	01121	EB1025	REF		
R30	D4-T2	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R31	E1-S4	Res, comp, 82Ω ±5%, 1/4w	4704-149484	01121	CB8205	1		
R32	K4-S2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R33	B4-S2	Res, comp, 1.2k ±5%, 1/4w	4704-190371	01121	CB1225	1		
R34	H3-S5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R35	E2-T4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R36	J4-T1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R37	J4-T2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R38	K5-T4	Res, comp, 10Ω ±5%, 1/4w	4704-147868	01121	CB1005	1		
R39	F5-T4	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	2		
R40	F5-Q4	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	REF		
		Transipad, nylon	3155-152207	17069	88000	4		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the Model 9500A, serial numbers 263 thru 272 and 344 and on. This assembly replaces the old micrologic assembly 9500A-4010, part number 1702-226597.						
A10		**CONTROL LOGIC P/C ASSEMBLY** **Figure 5-11**	1702-239947 (9500A-4028)	89536	1702-239947	REF		D
A1	K4-S4	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	3	1	
A2	C2-S4	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	REF		
A3	B1-S4	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	4	1	
A4	E4-S4	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A5	D3-S4	IC, RTL, Dual 4-Input Gate	3130-245274	04713	MC819P	1	1	
A6	I1-S4	IC, RTL, Dual Buffer	3130-245233	04713	MC899P	2	1	
A7	J3-S4	IC, RTL, Dual Buffer	3130-245233	04713	MC899P	REF		
A8	I4-S4	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A9	G1-S4	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A10	G5-S4	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	REF		
A11	F3-S4	IC, RTL, Hex Inverter	3130-245241	04713	MC889P	1	1	
C1	H2-S5	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	6		
C2	K2-R5	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C3	J4-Q1	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
C4	B4-S5	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C5	B4-T1	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C6	B4-S3	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C7	B4-S2	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C8	D1-S1	Cap, mica, 0.001 uf ±1%, 500v	1504-217844	88419	CD19F102F	2		
C9	C4-S2	Cap, mica, 0.001 uf ±1%, 500v	1504-217844	88419	CD19F102F	REF		
L1	J4-P5	Ferrite bead	2503-219535	02214	56-060-85-3B	1		
P1	H4-P4	Connector, 27 contact	2816-234922	91662	02-027-013-5-200	1		
Q1	F5-R1	Tstr, silicon, NPN	4805-159855	07910	CS23030	7	1	
Q2	F3-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q3	D4-R2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q4	E3-Q2	Tstr, silicon, PNP	4805-169375	04713	MPS3638	1	1	
Q5	E1-Q5	Tstr, silicon, NPN	4805-168708	03508	2N3391	3	1	
Q6	E3-Q5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q7	I3-R5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q8	C4-Q3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q9	C5-Q3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q10	D2-Q3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q11	D4-Q3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q12	J1-Q1	Tstr, germanium, PNP	4805-148643	01295	2N1307	3	1	
Q13	H4-Q2	Tstr, germanium, PNP	4805-148643	01295	2N1307	REF		
Q14	H4-Q4	Tstr, germanium, PNP	4805-148643	01295	2N1307	REF		
R1	F5-Q3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	6		
R2	F3-Q3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R3	E5-Q2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R4	F1-Q5	Res, comp, 5.6k ±5%, 1/4w	4704-148080	01121	CB5625	1		
R5	E5-Q4	Res, comp, 1.8k ±5%, 1/4w	4704-175042	01121	CB1825	1		
R6	E3-R1	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	1		
R7	E4-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	9		
R8	E1-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R9	E2-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R10	H5-R5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	2		
R11	C5-Q5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R12	D1-Q5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R13	D3-Q5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R14	B4-T3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R15	B4-T3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R16	C2-T3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R17	C2-T3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R18	D4-S5	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	2		
R19	E1-S5	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	REF		
R20	I5-R4	Res, comp, 1.2k ±5%, 1/4w	4704-190371	01121	CB1225	1		

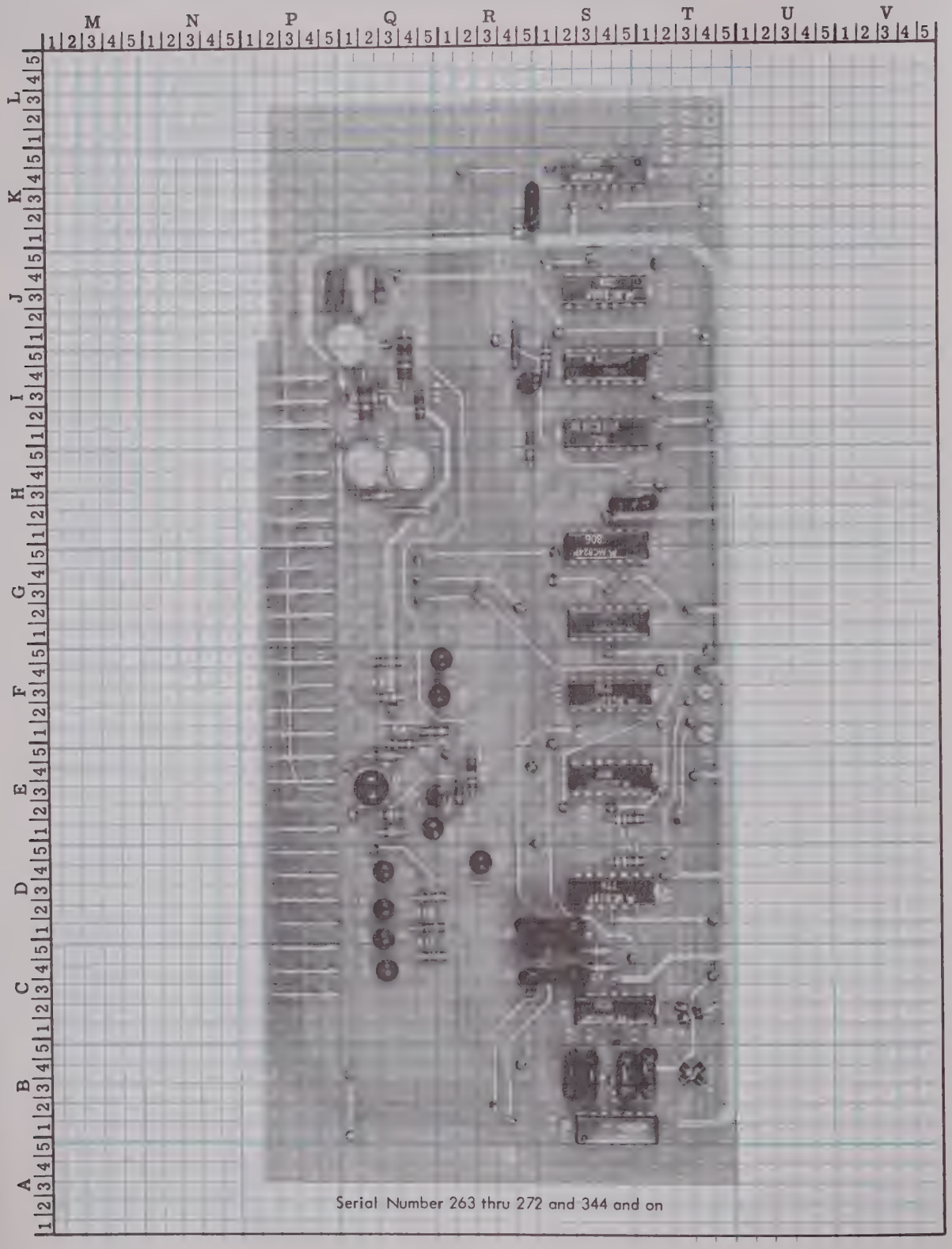


Figure 5-11. CONTROL LOGIC P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R21	C4-S3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R22	C5-S3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R23	J3-Q3	Res, comp, 82Ω ±5%, 1/4w	4704-149484	01121	CB8205	1		
R24	H2-Q4	Res, comp, 750Ω ±5%, 1/4w	4704-218024	01121	CB7515	1		
R25	I3-Q3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R26	I3-Q2	Res, comp, 1k ±5%, 1/2w	4704-108597	01121	EB1025	2		
R27	H3-Q2	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	2		
R28	I3-Q5	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	REF		
R29	I5-Q4	Res, comp, 1k ±5%, 1/2w	4704-108597	01121	EB1025	REF		
R30	I5-S1	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	1		
		Transipad, nylon	3155-152207	17069	88000	4		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the Model 9500A, serial numbers 123 thru 262 and 273 thru 343 only. For replacement of this assembly order the new dual in line assembly, 9500A-4029, part number 1702-239954. These two assemblies are electrically and mechanically interchangeable.						
A11		**CALIBRATION LOGIC P/C ASSEMBLY** **Figure 5-12**	1702-226605 (9500A-4011)	89536	1702-226605	REF		C
A2	B3-S1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	10	2	
A3	D3-S1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A4	E3-S1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A5	F3-S1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A6	G3-S1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A7	H3-S1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A8	I3-S1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A9	J4-S1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A10	K4-S1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
A11	C3-S2	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	6	1	
A12	E3-R3	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A13	G3-R3	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A14	I4-R3	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A15	K4-R3	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A16	H3-C5	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A17	F3-R1	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	REF		
C3	B5-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	16		
C4	B3-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C5	D5-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C6	D2-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C7	E5-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C8	E2-S4	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C9	F5-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C10	F3-S4	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
C11	G5-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C12	G3-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C13	H5-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C14	H3-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C15	I5-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C16	I3-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C17	J5-S2	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C18	J3-S3	Cap, mica, 220 pf ±5%, 500v	1504-237008	88419	CD19F221J	REF		
C19	C3-Q5	Cap, Ta, 15 uf ±10%, 20v	1508-153056	05397	K15C20K	1		
C20	A5-Q3	Cap, Ta, 150 uf +20/-15%, 15v	1508-160945	56289	109D157C201-5TO	1		
C21	I4-Q3	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
L1	I3-Q3	Ferrite bead	2503-219535	02214	56-060-85-3B	1		
P1	H2-P4	Connector, 22 contact	2816-234914	91662	02-022-013-5-200	1		
Q9	C1-P4	Tstr, silicon, NPN	4805-168708	03508	2N3391	4	1	
Q10	B3-P4	Tstr, unijunction	4805-186312	03508	2N2646	1	1	
Q11	D1-P4	Tstr, silicon, NPN	4805-159855	07910	CS23030	16	2	
Q12	E5-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q13	E5-Q3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q14	G3-Q4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q15	G2-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q16	D3-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q18	J1-Q3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q19	K4-Q3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q20	D3-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q21	D4-T4	Tstr, silicon, NPN	4805-222869	03508	X16E2300	8	1	
Q22	E3-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q23	E5-T3	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q24	F3-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q25	F5-T2	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q26	G4-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		

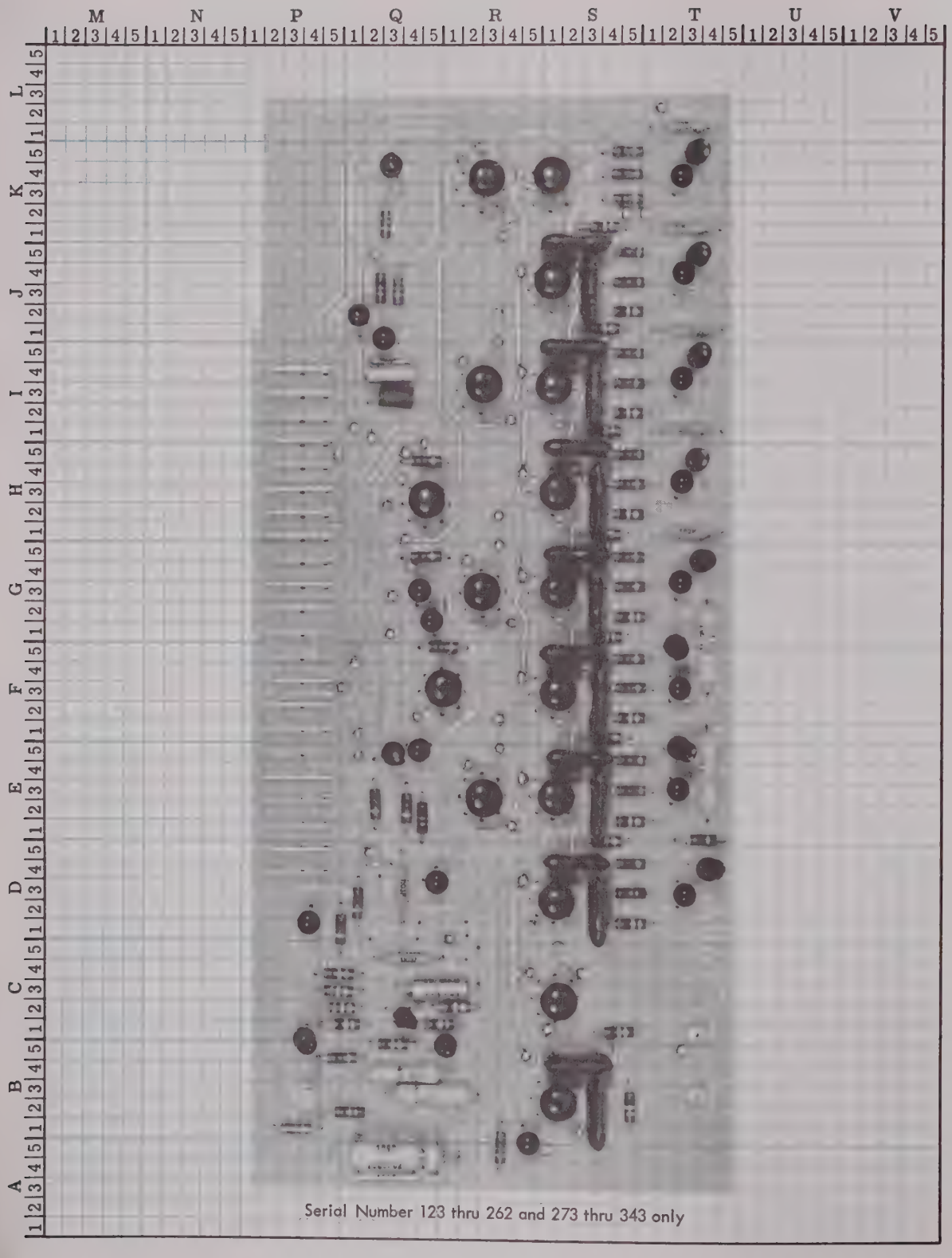


Figure 5-12. CALIBRATION LOGIC P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q27	G5-T4	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q28	H4-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q29	H5-T3	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q30	I4-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q31	I5-T3	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q32	J4-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q33	J5-T3	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q34	K4-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q35	K5-T3	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q36	B5-R1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q37	C2-Q4	Tstr, silicon, PNP	4805-169375	04713	MPS3638	1	1	
Q39	J2-Q1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q40	B1-R5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
R1	D1-P5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	26		
R2	B4-Q4	Res, met flm, 3.92k ±1%, 1/2w	4705-160713	75042	Type CEC-TO	1		
R3	C1-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	19		
R4	B2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R5	E1-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R6	D1-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R7	F1-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R8	E2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R9	G1-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R10	F2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R11	H1-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R12	G2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R13	I1-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R14	H2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R15	J1-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R16	I2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R17	K1-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R18	J2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R19	D5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R20	E5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R21	F5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R22	G5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R23	H5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R24	I5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R25	J5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R26	K5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R27	E1-T4	Res, comp, 4.7M ±5%, 1/4w	4704-220046	01121	CB4755	1		
R28	E4-T4	Res, met flm, 2.26M ±1%, 1/2w	4705-221564	75042	Type CEC-TO	1		
R29	G1-T4	Res, met flm, 1.13M ±1%, 1/2w	4705-221556	75042	Type CEC-TO	1		
R30	H1-T3	Res, met flm, 562k ±1%, 1/8w	4705-235358	75042	Type CEC-TO	1		
R31	I1-T3	Res, met flm, 280k ±1%, 1/8w	4705-235267	75042	Type CEC-TO	1		
R32	J1-T3	Res, met flm, 140k ±0.5%, 1/8w	4705-233148	75042	Type CEA	1		
R33	K1-T2	Res, met flm, 70k ±0.1%, 1/8w	4705-233155	75042	Type CEA	1		
R34	L1-T3	Res, met flm, 35k ±0.1%, 1/8w	4705-229443	75042	Type CEA	1		
R35	C1-Q1	Res, comp, 300k ±5%, 1/4w	4704-234682	01121	CB3045	1		
R36	B5-Q1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R37	B2-Q1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R38	D2-Q1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R39	B1-P3	Res, comp, 120Ω ±5%, 1/4w	4704-170712	01121	CB1215	2		
R40	E2-Q4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R41	E2-Q2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R42	K4-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R43	A5-R4	Res, comp, 120Ω ±5%, 1/4w	4704-170712	01121	CB1215	REF		
R44	H5-Q5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	2		
R45	F5-R1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R46	G5-Q5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R47	E2-Q5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R48	D3-Q4	Res, met flm, 110k ±1%, 1/8w	4705-234708	75042	Type CEA-TO	2		
R49	C5-Q4	Res, met flm, 110k ±1%, 1/8w	4705-234708	75042	Type CEA-TO	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R50	B5-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R53	J3-Q3	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	2		
R54	K2-Q3	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	REF		
R55	D3-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R56	E3-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R57	F3-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R58	G3-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R59	H4-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R60	I4-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R61	J4-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R62	K3-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R63	B3-Q5	Res, met flm, 2.8k ±1%, 1/2w	4705-193110	75042	Type CEC-TO	1		
R64	C1-Q5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R65	C2-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R66	C4-P5	Res, comp, 820k ±5%, 1/4w	4704-220541	01121	CB8245	1		
R67	C3-P5	Res, comp, 560k ±5%, 1/4w ▷5◁	4704-220533	01121	CB5645	1		
R68	C2-P5	Res, comp, 360k ±5%, 1/4w ▷5◁	4704-234690	01121	CB3645	1		
R69	J4-Q2	Res, comp, 1k ±5%, 1/4w ▷5◁	4704-148023	01121	CB1025	REF		
		Transipad, nylon	3155-152207	17069	88000	1		

▷5◁ R66, R67 or R68 may not be installed.

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the Model 9500A, serial numbers 263 thru 272 and 344 and on. This assembly replaces the old micrologic assembly 9500A-4011, part number 1702-226605.						
A11		**CALIBRATION LOGIC P/C ASSEMBLY** **Figure 5-13**	1702-239954 (9500A-4029)	89536	1702-239954	REF		D
A1	B2-S1	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	3	1	
A2	C1-S1	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	5	1	
A3	F3-S1	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A4	G3-S1	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A5	J4-S1	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A6	K3-S1	IC, RTL, Dual JK Flip Flop	3130-223206	04713	MC890P	REF		
A7	D4-S1	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	REF		
A8	I1-S1	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	REF		
C1	J2-Q3	Cap, Ta, 15 uf ±10%, 20v	1508-153056	05397	K15C20K	1		
C2	G5-R1	Cap, Ta, 150 uf +20/-15%, 15v	1508-160945	56289	109D157C-2015TO	1		
C3	C4-S2	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	16		
C4	C4-S3	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C5	C4-R5	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C6	C4-R4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C7	E3-R5	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C8	E3-R4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C9	E3-S2	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C10	E3-S3	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C11	H2-S2	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C12	H2-S3	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C13	H2-R5	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C14	H2-R4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C15	I5-R5	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C16	I5-R4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C17	I5-S2	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
C18	I5-S3	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	REF		
C19	J3-P5	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
L1	J3-P3	Ferrite bead	2503-219535	02214	56-060-85-3B	1		
P1	H4-P4	Connector, 22 contact	2816-234914	91662	02-022-013-5-200	1		
Q3	J1-Q2	Tstr, silicon, NPN	4805-168708	03508	2N3391	5	1	
Q4	J5-Q2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q5	J5-Q4	Tstr, silicon, PNP	4805-169375	04713	MPS3638	1	1	
Q6	E1-Q4	Tstr, silicon, NPN	4805-159855	07910	CS23030	14	2	
Q7	E3-Q3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q8	D4-Q3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q9	F2-Q1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q10	G4-Q4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q11	G2-Q4	Tstr, unijunction	4805-186312	03508	2N2646	1	1	
Q12	F5-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q13	G1-Q2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q14	F1-Q3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q15	B1-S4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q16	C3-T3	Tstr, silicon, NPN	4805-222869	03508	X16E2300	8	1	
Q17	C2-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q18	F3-T4	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q19	F4-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q20	E5-T4	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q21	E5-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q22	G5-T4	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q23	G4-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q24	G2-T4	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q25	G1-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q26	J5-T4	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q27	K1-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q28	J2-T4	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		

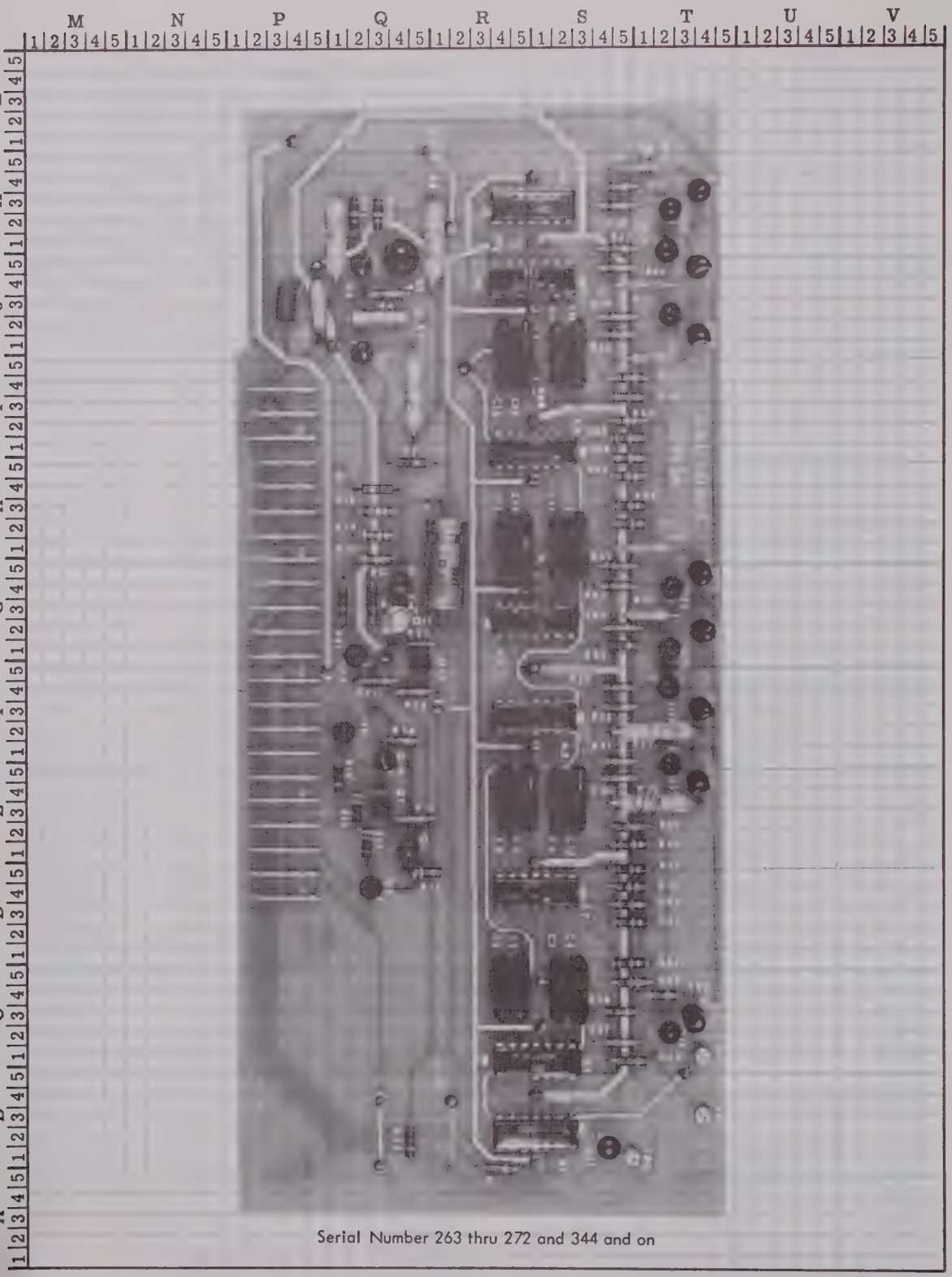


Figure 5-13. CALIBRATION LOGIC P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q29	J3-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q30	K3-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q31	K4-T4	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
R1	A5-R4	Res, comp, 2.2k ±5%, 1/4w	4705-148049	01121	CB2225	1		
R5	I4-Q5	Res, met flm, 54.9k ±1%, 1/2w	4705-176669	75042	Type CEC-TO	1		
R6	J4-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	19		
R7	H5-Q4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	25		
R8	K1-R1	Res, met flm, 3.92k ±1%, 1/2w	4705-160713	75042	Type CEC-TO	1		
R9	K1-Q1	Res, met flm, 2.8k ±1%, 1/2w	4705-193110	75042	Type CEC-TO	1		
R10	K2-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R11	K2-Q2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R12	D5-Q5	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	3		
R13	E3-Q5	Res, comp, 680Ω ±5%, 1/4w	4704-148007	01121	CB6815	1		
R14	E3-Q2	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	REF		
R15	E1-Q2	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	REF		
R16	E5-Q1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R17	H4-Q3	Res, comp, 820k ±5%, 1/4w 6	4704-220541	01121	CB8245	1		
R18	H3-Q3	Res, comp, 560k ±5%, 1/4w 6	4704-220533	01121	CB5645	1		
R19	H2-Q3	Res, comp, 360k ±5%, 1/4w 6	4704-234690	01121	CB3645	1		
R20	G5-Q3	Res, comp, 300k ±5%, 1/4w	4704-234682	01121	CB3045	1		
R21	G3-Q1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R22	G3-Q3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R23	G1-Q5	Res, comp, 120Ω ±5%, 1/4w	4704-170712	01121	CB1215	2		
R24	F4-Q5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R25	F5-Q3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R26	F2-Q4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R27	B2-Q4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R28	C4-T2	Res, comp, 4.7M ±5%, 1/4w	4704-220046	01121	CB4755	1		
R29	F2-T2	Res, met flm, 2.26M ±1%, 1/2w	4705-221564	75042	Type CEC-TO	1		
R30	E4-T1	Res, met flm, 1.13M ±1%, 1/2w	4705-221556	75042	Type CEC-TO	1		
R31	H1-T1	Res, met flm, 562k ±1%, 1/8w	4705-235358	75042	Type CEA-TO	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R32	G3-T1	Res, met flm, 280k ±1%, 1/8w	4705-235267	75042	Type CEA-TO	1		
R33	J4-T1	Res, met flm, 140k ±0.5%, 1/8w	4705-233148	75042	Type CEA	1		
R34	I5-T1	Res, met flm, 70k ±0.1%, 1/8w	4705-233155	75042	Type CEA	1		
R35	K5-T1	Res, met flm, 35k ±0.1%, 1/8w	4705-229443	75042	Type CEA	1		
R36	C3-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R37	C2-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R38	F3-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R39	F4-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R40	E5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R41	F1-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R42	G5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R43	G4-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R44	G2-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R45	G1-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R46	J5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R47	K1-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R48	J2-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R49	J2-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R50	K3-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R51	K4-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R52	C1-S5	Res, comp, 120Ω ±5%, 1/4w	4704-170712	01121	CB1215	REF		
R53	C5-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R54	D1-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R55	D3-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R56	D3-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R57	D5-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R58	D4-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R59	E2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R60	E1-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R61	H2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R62	H3-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q29	J3-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q30	K3-T2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q31	K4-T4	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
R1	A5-R4	Res, comp, 2.2k ±5%, 1/4w	4705-148049	01121	CB2225	1		
R5	I4-Q5	Res, met flm, 54.9k ±1%, 1/2w	4705-176669	75042	Type CEC-TO	1		
R6	J4-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	19		
R7	H5-Q4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	25		
R8	K1-R1	Res, met flm, 3.92k ±1%, 1/2w	4705-160713	75042	Type CEC-TO	1		
R9	K1-Q1	Res, met flm, 2.8k ±1%, 1/2w	4705-193110	75042	Type CEC-TO	1		
R10	K2-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R11	K2-Q2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R12	D5-Q5	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	3		
R13	E3-Q5	Res, comp, 680Ω ±5%, 1/4w	4704-148007	01121	CB6815	1		
R14	E3-Q2	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	REF		
R15	E1-Q2	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	REF		
R16	E5-Q1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R17	H4-Q3	Res, comp, 820k ±5%, 1/4w 6	4704-220541	01121	CB8245	1		
R18	H3-Q3	Res, comp, 560k ±5%, 1/4w 6	4704-220533	01121	CB5645	1		
R19	H2-Q3	Res, comp, 360k ±5%, 1/4w 6	4704-234690	01121	CB3645	1		
R20	G5-Q3	Res, comp, 300k ±5%, 1/4w	4704-234682	01121	CB3045	1		
R21	G3-Q1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R22	G3-Q3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R23	G1-Q5	Res, comp, 120Ω ±5%, 1/4w	4704-170712	01121	CB1215	2		
R24	F4-Q5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R25	F5-Q3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R26	F2-Q4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R27	B2-Q4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R28	C4-T2	Res, comp, 4.7M ±5%, 1/4w	4704-220046	01121	CB4755	1		
R29	F2-T2	Res, met flm, 2.26M ±1%, 1/2w	4705-221564	75042	Type CEC-TO	1		
R30	E4-T1	Res, met flm, 1.13M ±1%, 1/2w	4705-221556	75042	Type CEC-TO	1		
R31	H1-T1	Res, met flm, 562k ±1%, 1/8w	4705-235358	75042	Type CEA-TO	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R32	G3-T1	Res, met flm, 280k ±1%, 1/8w	4705-235267	75042	Type CEA-TO	1		
R33	J4-T1	Res, met flm, 140k ±0.5%, 1/8w	4705-233148	75042	Type CEA	1		
R34	I5-T1	Res, met flm, 70k ±0.1%, 1/8w	4705-233155	75042	Type CEA	1		
R35	K5-T1	Res, met flm, 35k ±0.1%, 1/8w	4705-229443	75042	Type CEA	1		
R36	C3-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R37	C2-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R38	F3-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R39	F4-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R40	E5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R41	F1-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R42	G5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R43	G4-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R44	G2-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R45	G1-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R46	J5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R47	K1-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R48	J2-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R49	J2-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R50	K3-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R51	K4-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R52	C1-S5	Res, comp, 120Ω ±5%, 1/4w	4704-170712	01121	CB1215	REF		
R53	C5-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R54	D1-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R55	D3-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R56	D3-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R57	D5-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R58	D4-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R59	E2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R60	E1-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R61	H2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R62	H3-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R63	H5-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R64	H5-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R65	I2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R66	I2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R67	I4-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R68	I3-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R69	I4-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
		Transipad, nylon	3155-152207	17069	88000	1		

6 R17, R18 or R19 may not be installed.

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the model 9500A, serial numbers 123 thru 262 and 273 thru 343 only. For replacement of this assembly, order the new dual in line assembly, 9500A-4030, part number 1702-239962. These two assemblies are electrically and mechanically interchangeable.						
A12		**SAMPLE CIRCUITS P/C ASSEMBLY** **Figure 5-14**	1702-226613 (9500A-4012)	89536	1702-226613	REF		C
A1	D5-S4	IC, RTL, Buffer	3130-218495	07263	U8A990028	2	1	
A2	D5-R4	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	2	1	
A3	D1-T3	IC, RTL, Buffer	3130-218495	07263	U8A990028	REF		
A4	C3-S3	IC, RTL, Dual 2-Input Gate	3130-218487	07263	U8A991428	REF		
A5	G3-R4	IC, RTL, JK Flip Flop	3130-218479	07263	U8A992328	1	1	B
C1	J4-R2	Cap, plstc, 0.47 uf ±20%, 250v	1507-184366	73445	C280AE/P470-K	2		
C2	J3-Q3	Cap, Ta, 10 uf ±20%, 15v	1508-193623	56289	196D106X0015	1		
C3	J4-S2	Cap, plstc, 0.47 uf ±20%, 250v	1507-184366	73445	C280AE/P470-K	REF		
C4	F2-Q5	Cap, Ta, 15 uf ±10%, 20v	1508-153056	05397	K15C20K	2		
C5	F4-Q5	Cap, Ta, 33 uf ±10%, 10v	1508-182832	05397	K33C10K	1		
C6	F4-R5	Cap, Ta, 15 uf ±10%, 20v	1508-153056	05397	K15C20K	REF		
C7	E2-R4	Cap, Ta, 2.2 uf ±20%, 20v	1508-161927	56289	196D225X0020	1		
C8	A5-Q5	Cap, cer, 0.005 uf ±20%, 1 kv	1501-105650	56289	C023B102H50-2M	4		
C9	C5-Q5	Cap, cer, 0.005 uf ±20%, 1 kv	1501-105650	56289	C023B102H50-2M	REF		
C10	B2-Q5	Cap, cer, 0.005 uf ±20%, 1 kv	1501-105650	56289	C023B102H50-2M	REF		
C11	C1-Q5	Cap, cer, 0.005 uf ±20%, 1 kv	1501-105650	56289	C023B102H50-2M	REF		
C12	H1-R5	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	1		
C13	I3-Q3	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
CR1	K1-R3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	3	1	
CR2	K4-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR3	E1-S2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
L1	I1-Q3	Ferrite bead	2503-219535	02214	56-060-85-3B	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
P1	H4-P4	Connector, 27 contact	2816-234922	91662	02-027-013-5-200	1		
Q1	J2-R4	Tstr, silicon, NPN	4805-218396	04713	2N3904	4	1	
Q2	J2-Q5	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q3	K3-Q2	Tstr, silicon, NPN	4805-218503	03508	2N3877A	4	1	
Q4	J2-Q2	Tstr, silicon, NPN	4805-159855	07910	CS23030	7	1	
Q5	K3-Q5	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q6	K2-R5	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q7	F4-T3	Tstr, silicon, PNP	4805-195974	04713	2N3906	1	1	
Q8	T2-R4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q9	G1-S5	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q10	F1-S4	Tstr, unijunction	4805-186312	03508	2N2646	1	1	
Q11	G5-S3	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q12	H2-S3	Tstr, silicon, NPN	4805-218503	03508	2N3877A	REF		
Q13	C4-R3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q14	C5-T1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q15	B1-Q2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q16	B3-R2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q17	C1-R3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
R1	I5-R5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	3		
R2	I5-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R3	I3-R1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	8		
R4	I3-R5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R5	K1-Q1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	2		
R7	J3-Q1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R8	J5-R4	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	3		
R9	K3-S2	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	REF		
R11	H3-R5	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	1		
R12	G1-Q5	Res, met flm 10k ±1%, 1/8w	4705-168260	75042	Type CEA-T0	1		
R13	G3-T1	Res, met flm, 5.62k ±1%, 1/8w	4705-235168	75042	Type CEA-T0	1		
R14	G1-T2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		

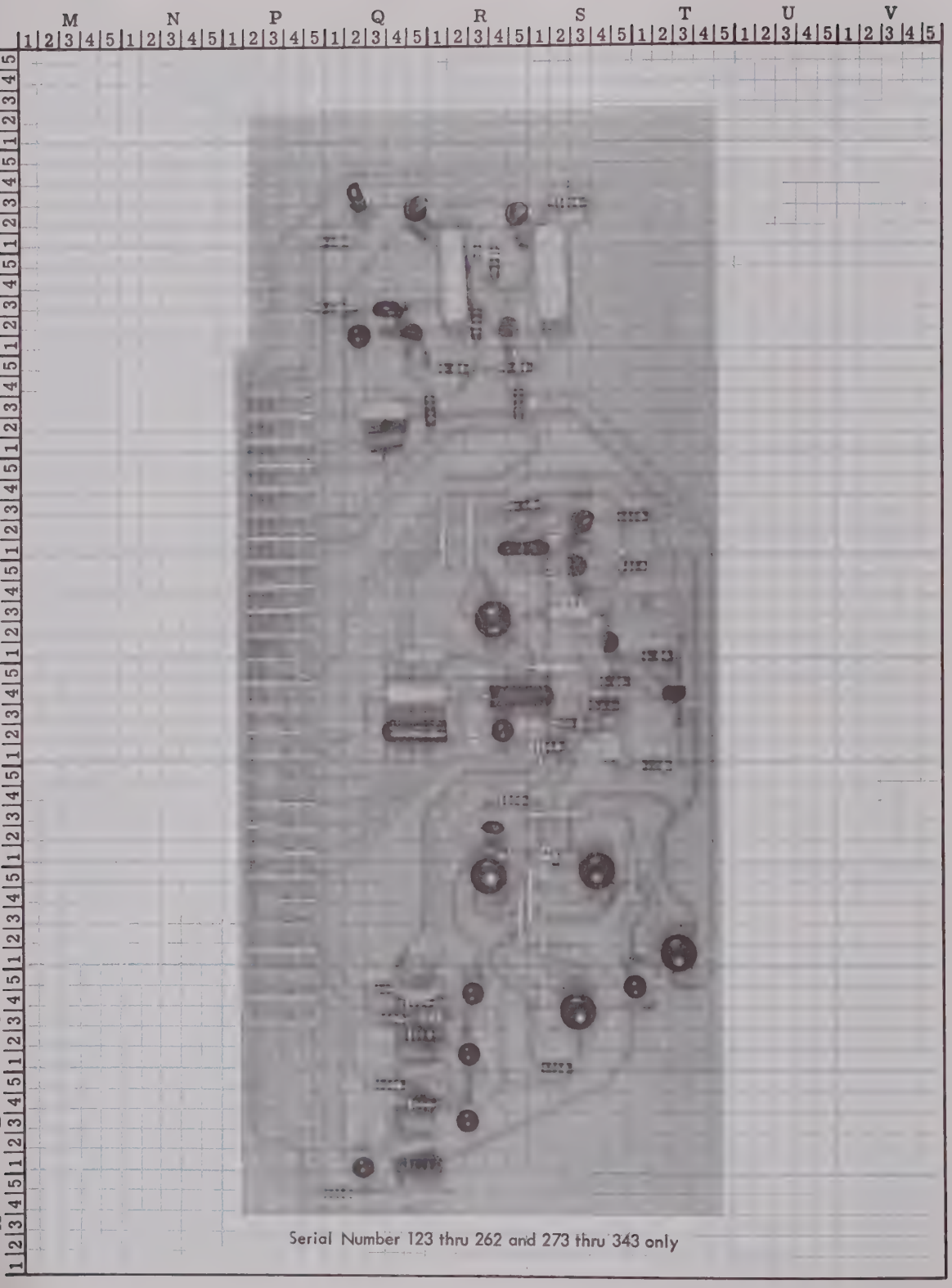


Figure 5-14. SAMPLE CIRCUITS P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R15	F5-S5	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	1		
R16	E5-T2	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	1		
R17	F1-S1	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	1		A
R17	F1-S1	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	1		B
R18	E4-R5	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	REF		
R19	F3-S4	Res, comp, 10Ω ±5%, 1/4w	4704-147868	01121	CB1005	1		
R20	G3-S3	Res, met flm, 4.02k ±1%, 1/8w	4705-235325	75042	Type CEA-T0	1		
R21	G5-T1	Res, comp, 330Ω ±5%, 1/4w	4704-147967	01121	CB3315	1		
R23	H3-T1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R24	F3-S3	Res, comp, 22Ω ±5%, 1/4w	4704-147884	01121	CB2205	1		
R25	C5-Q3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R26	A5-Q1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R27	B1-Q5	Res, comp, 910Ω ±5%, 1/4w	4704-203851	01121	CB9115	4		
R28	C3-Q4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R29	B5-Q4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R30	C1-S2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R31	C4-Q5	Res, comp, 910Ω ±5%, 1/4w	4704-203851	01121	CB9115	REF		
R32	B4-Q5	Res, comp, 910Ω ±5%, 1/4w	4704-203851	01121	CB9115	REF		
R33	C2-Q5	Res, comp, 910Ω ±5%, 1/4w	4704-203851	01121	CB9115	REF		
R34	J2-R3	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	1		
R35	F5-S2	Res, met flm, 40.2k ±1%, 1/8w	4705-235333	75042	Type CEA-T0	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		NOTE: This assembly is used in the Model 9500A, serial numbers 263 thru 272 and 344 and on. This assembly replaces the old micrologic assembly 9500A-4012, part number 1702-226613.						
A12		**SAMPLE CIRCUITS P/C ASSEMBLY** **Figure 5-15**	1702-239962 (9500A-4030)	89536	1702-239962	REF		D
A1	C1-T1	IC, RTL, Quad 2-Input Gate	3130-223214	04713	MC824P	1	1	
A2	D1-T1	IC, RTL, Dual Buffer	3130-245233	04713	MC899P	1	1	
A3	F4-S1	IC, RTL, JK Flip Flop	3130-245266	04713	MC816P	1	1	
C1	H5-Q4	Cap, Ta, 10 uf ±20%, 15v	1508-193623	56289	196D106X0015	1		
C2	H5-R3	Cap, plstc, 0.47 uf ±20%, 250v	1507-184366	73445	C280AE/ P470K	2		
C3	H5-S2	Cap, plstc, 0.47 uf ±20%, 250v	1507-184366	73445	C280AE/ P470K	REF		
C4	G1-Q4	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	1		
C5	F3-Q3	Cap, Ta, 15 uf ±10%, 20v	1508-153056	05397	K15C20K	2		
C6	F1-Q4	Cap, Ta, 33 uf ±10%, 10v	1508-182832	05397	K33C10K	1		
C7	E3-R1	Cap, Ta, 15 uf ±10%, 20v	1508-153056	05397	K15C20K	REF		
C8	C3-T2	Cap, Ta, 2.2 uf ±20%, 20v	1508-161927	56289	196D225X0020	1		
C9	I5-Q1	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/ P47K	1		
C10	B5-R3	Cap, cer, 0.005 uf ±20%, 1kv	1501-105650	56289	C023B102H-502M	4		
C11	D1-R3	Cap, cer, 0.005 uf ±20%, 1kv	1501-105650	56289	C023B102H-502M	REF		
C12	C2-R3	Cap, cer, 0.005 uf ±20%, 1kv	1501-105650	56289	C023B102H-502M	REF		
C13	C5-R3	Cap, cer, 0.005 uf ±20%, 1kv	1501-105650	56289	C023B102H-502M	REF		
CR1	I5-R2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	3	1	
CR2	I5-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR3	D4-S4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
L1	I5-Q3	Ferrite bead	2503-219535	02214	56-060-85-3B	1		
P1	H4-P4	Connector, 27 contact	2816-234922	91662	02-027-013-5-200	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q1	H2-R5	Tstr, silicon, NPN	4805-218396	04713	2N3904	4	1	
Q2	I3-R1	Tstr, silicon, NPN	4805-159855	07910	CS23030	7	1	
Q3	H2-R1	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q4	I3-R5	Tstr, high voltage, NPN	4805-245480	03877	ST81011	4	1	
Q5	H2-S4	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q6	I3-S4	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q7	F4-R2	Tstr, high voltage, NPN	4805-245480	03877	ST81011	REF		
Q8	E5-S2	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q9	E3-S5	Tstr, silicon, PNP	4805-195974	04713	2N3906	1	1	
Q10	E1-R5	Tstr, silicon, NPN	4805-218396	04713	2N3904	REF		
Q11	E1-S3	Tstr, unijunction	4805-186312	03508	2N2646	1	1	
Q12	D5-Q2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q13	B5-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q14	D2-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q15	C2-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q16	C4-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q17	C4-S3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
R1	H2-Q4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	8		
R2	G5-R4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R3	I5-Q5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	2		
R4	G5-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	4		
R5	G5-Q4	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	1		
R6	G5-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R7	I5-R4	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	3		
R8	G5-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R9	I5-S3	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	REF		
R10	F5-Q3	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	1		
R11	G1-R2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R12	E3-Q2	Res, met flm, 10k ±1%, 1/8w	4705-168260	75042	Type CEA-TO	1		
R13	E3-Q3	Res, met flm, 40.2k ±1%, 1/8w	4705-235333	75042	Type CEA-TO	1		
R14	E2-R2	Res, comp, 10Ω ±5%, 1/4w	4704-147868	01121	CB1005	1		

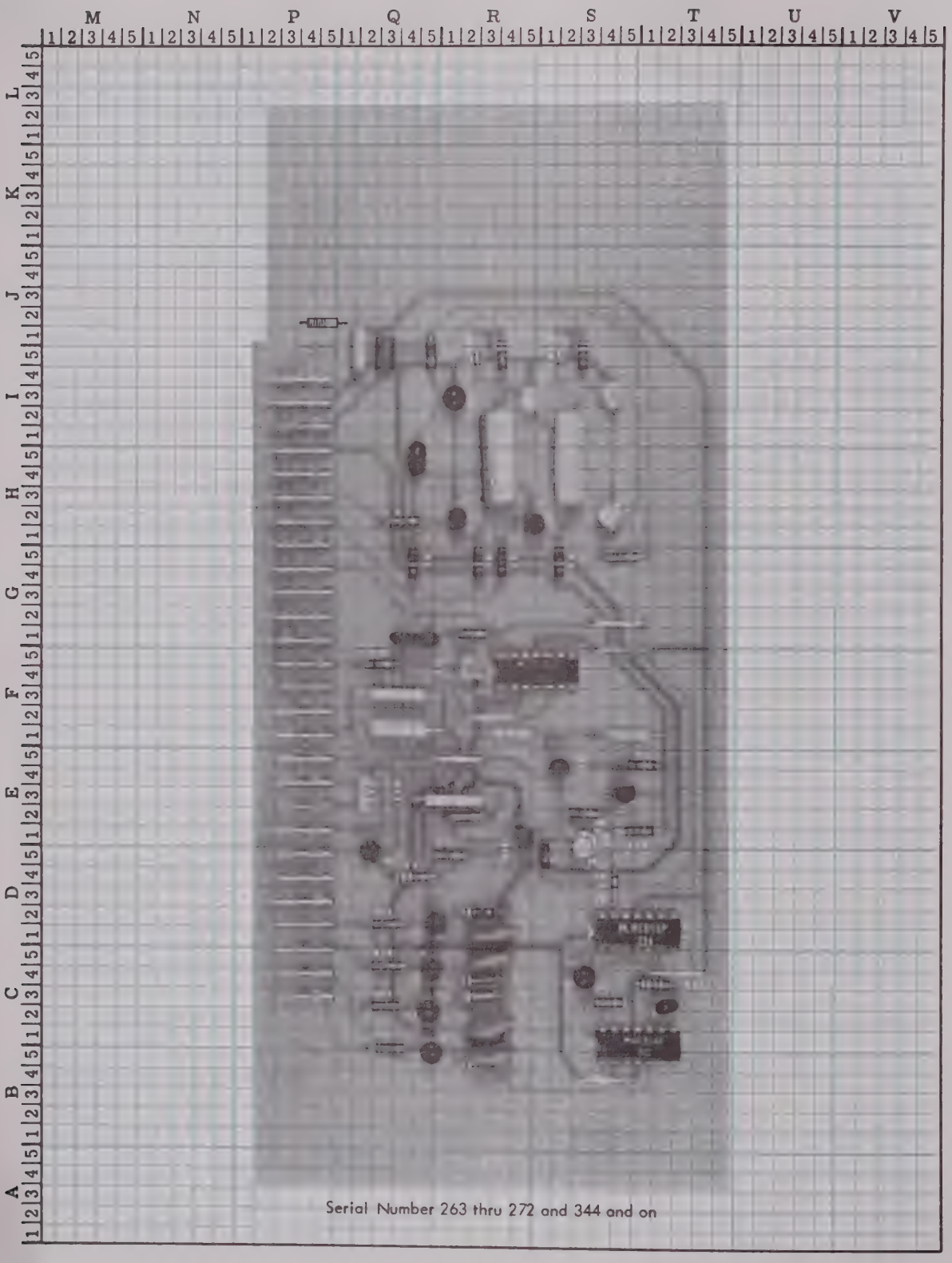


Figure 5-15. SAMPLE CIRCUITS P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R15	F1-S5	Res, met flm, 5.62k ±1%, 1/8w	4705-235168	75042	Type CEA-TO	1		
R16	E5-T1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R17	E2-S3	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	2		
R18	D5-S1	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	REF		
R19	E1-T1	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	1		
R20	D5-R1	Res, comp, 22Ω ±5%, 1/4w	4704-147884	01121	CB2205	1		
R21	D4-Q4	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	1		
R22	C4-T1	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	REF		
R23	C1-Q3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R24	B5-R2	Res, comp, 910Ω ±5%, 1/4w	4704-203851	01121	CB9115	4		
R25	D2-Q3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R26	D2-R3	Res, comp, 910Ω ±5%, 1/4w	4704-203851	01121	CB9115	REF		
R27	C3-Q3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R28	C5-Q3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R29	C3-R3	Res, comp, 910Ω ±5%, 1/4w	4704-203851	01121	CB9115	REF		
R30	C4-R3	Res, comp, 910Ω ±5%, 1/4w	4704-203851	01121	CB9115	REF		
R31	C3-S4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R32	F1-R4	Res, met flm, 4.02k ±1%, 1/8w	4705-235325	75042	Type CEA-TO	1		
R33	J2-P4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
		Transipad, nylon	3155-152207	17069	88000	4		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A13		**ANALOG FEEDBACK P/C ASSEMBLY Figure 5-16**	1702-242545 (9500A-4023)	89536	1702-242545	REF		
C1	J1-S2	Cap, cer, 15 pf ±10%, 500v	1501-159947	00656	Type C1-1	1		
C2	J1-S1	Cap, cer, 3 pf ±0.1 pf, 50v	1501-209577	95275	VY10CA3ROB-A	1		
C3	I5-S4	Cap, var, air, 0.8-10 pf, 250v	1509-229930	91293	JMC2951	2		
C4	J3-S4	Cap, var, air, 0.8-10 pf, 250v	1509-229930	91293	JMC2951	REF		
C5	J5-S1	Cap, cer, 20 pf ±5%, 50v	1501-240770	00656	Type C1-1	1		
C6		Cap, cer, 5.1 pf, matched pair (underneath R169)	1501-199687	89536	1501-199687	1		
C7	I5-T1	Cap, var, cer, 2-8 pf, 350v	1509-229955	72982	538-006-C0P0-89R	1		
C8	K1-S1	Cap, cer, 220 pf ±5%, 50v	1501-217919	95275	VY10CA221JA	1		
C9	J3-T1	Cap, mica, factory selected	▷7					
C10	J5-T1	Cap, var, cer, 7-25 pf, 350v	1509-229948	72982	538-006-B2P0-93R	1		
C11	K2-S3	Cap, cer, 2,200 pf ±5%, 50v	1501-217927	95275	VY20CA222JA	1		
C12	J5-S4	Cap, mica, factory selected	▷7					
C13	K1-S4	Cap, mica, factory selected	▷7					
C14	L1-Q3	Cap, plstc, 0.1 uf ±10%, 600v	1507-233908	84411	Type X663F	1		
C15	J3-R1	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	4		
C16	J5-Q5	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C17	K1-Q1	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C18	I5-Q5	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C19	D2-T1	Cap, mica, 27 pf ±5%, 500v	1504-177998	88419	CD15E270J	1		
C20	E1-T1	Cap, mica, 10 pf ±10%, 500v	1504-175216	88419	CD15C0100K	1		
C21	H4-S4	Cap, var, glass, 0.5-3 pf	1509-195982	73899	ST851	1		
C22	C3-R5	Cap, mica, 2 pf ±0.5 pf, 500v	1504-175208	84171	DM15020K	1		
C23	K5-P5	Cap, mica, 33 pf ±5%, 500v	1504-160317	88419	CD15E330J	1		
CR1	I5-R2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	5	1	
CR2	J2-R2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR3	J5-R2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR4	K2-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
CR5	I3-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
J1	L1-S5	Connector, female, coaxial	2106-229013	95712	DM5310-1	1		
K1	I2-S2	Relay						
		Switch, dry reed	5103-219097	15898	765972	7		
		Switch, dry reed	5103-219097	15898	765972	REF		
		Coil, reed relay, 12v	1802-229971	71707	UD-12P	2		
K2	J1-R2	Relay						
		Switch, dry reed	5103-219097	15898	765972	REF		
		Coil, reed relay, 12v	1802-229989	71707	U-12P	3		
K3	J4-R1	Relay						
		Switch, dry reed	5103-219097	15898	765972	REF		
		Coil, reed relay, 12v	1802-229989	71707	U-12P	REF		
K4	K1-R1	Relay						
		Switch, dry reed	5103-219097	15898	765972	REF		
		Coil, reed relay, 12v	1802-229989	71707	U-12P	REF		
K5	K3-Q3	Relay						
		Switch, dry reed	5103-219097	15898	765972	REF		
		Switch, dry reed	5103-219097	15898	765972	REF		
		Coil, reed relay, 12v	1802-229971	71707	UD-12P	REF		
L1	K2-R4	Inductor, 1.2 uh, 2,200 ma	1801-245498	72259	WEE-1.2	1		
P1	H4-Q1	Connector, 35 contact	2816-234948	91662	02-035-013-5-200	1		
Q1	E2-S5	Tstr, silicon, NPN	4805-225607	12040	SL339	25	4	
Q2	E2-S2	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q3	E2-Q4	Tstr, silicon, NPN	4805-168708	03508	2N3391	5	1	
Q4	D3-S5	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q5	D2-S3	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q6	D2-Q4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q7	C5-S5	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q8	C5-R5	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q9	C5-Q3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q10	C3-S5	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q11	C2-R3	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q12	A5-S5	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q13	A5-R4	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q14	A5-Q2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q15	B2-S5	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q16	B2-R4	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q17	B3-Q2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q18	B4-S3	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q19	B5-S2	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q20	C1-S1	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q21	F3-S1	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q22	F1-S1	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q23	E5-R5	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q24	G3-S1	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q25	G2-S1	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q26	F5-R5	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q27	F4-R5	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q28	H2-S1	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q29	H1-R5	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q30	G5-R5	Tstr, silicon, NPN	4805-225607	12040	SL339	REF		
Q31	E1-R1	Tstr, silicon, PNP, matched to R170	8					
Q32	D2-R1	Tstr, silicon, PNP, matched to R171	8					
Q33	C5-Q5	Tstr, silicon, PNP, matched to R172	8					
Q34	A5-Q4	Tstr, silicon, PNP, matched to R173	8					
Q35	B2-Q4	Tstr, silicon, PNP, matched to R174	8					
Q36	E3-R5	Tstr, silicon, NPN, matched to R175	9					
Q37	D3-R5	Tstr, silicon, NPN, matched to R176	9					
Q38	I2-R1	Tstr, silicon, NPN, matched to R177	9					
R1	D5-S5	Res, ww, 1.25k, matched	10					
R2	E1-S3	Res, ww, 500Ω, matched	10					
R3	D5-S2	Res, ww, 500Ω, matched	10					
R4	D5-R3	Res, ww, 2.5k, matched	10					

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R5	E4-R4	Res, comp, 1Ω ±5%, 1/2w	4704-218693	01121	EB10G5	8		
R6	E1-R1	Res, comp, 91Ω ±5%, 1/4w	4704-221887	01121	CB9105	1		
R7	E3-R2	Res, comp, 1Ω ±5%, 1/2w	4704-218693	01121	EB10G5	REF		
R8	E1-R4	Res, met flm, 16.2k ±1%, 1/8w	4705-226233	75042	Type CEA-T0	5		
R9	E1-R3	Res, met flm, 30.1k ±1%, 1/8w	4705-168286	75042	Type CEA-T0	5		
R10	E3-S2	Res, met flm, 18.2k ±1%, 1/8w	4705-236810	75042	Type CEA-T0	2		
R11	E4-S2	Res, met flm, 90.9k ±1%, 1/8w	4705-223537	75042	Type CEA-T0	2		
R12	E3-S3	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	12		
R13	E3-S4	Res, comp, 47k ±5%, 1/4w	4704-148163	01121	CB4735	5		
R14	E3-T1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	4		
R15	E3-S5	Res, comp, 11k ±5%, 1/4w	4704-221580	01121	CB1135	2		
R16	E4-Q4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	8		
R17	D1-T1	Res, ww, 2.5k, matched	10					
R18	D2-S4	Res, ww, 500Ω, matched	10					
R19	D1-S2	Res, ww, 500Ω, matched	10					
R20	D1-R3	Res, ww, 6k, matched	10					
R21	D4-R4	Res, comp, 1Ω ±5%, 1/2w	4704-218693	01121	EB10G5	REF		
R22	D1-R1	Res, comp, 240Ω ±5%, 1/4w	4704-221895	01121	CB2415	1		
R23	D4-R2	Res, comp, 1Ω ±5%, 1/2w	4704-218693	01121	EB10G5	REF		
R24	D2-R4	Res, met flm, 16.2k ±1%, 1/8w	4705-226233	75042	Type CEA-T0	REF		
R25	D2-R4	Res, met flm, 30.1k ±1%, 1/8w	4705-168286	75042	Type CEA-T0	REF		
R26	D4-S2	Res, met flm, 18.2k ±1%, 1/8w	4705-236810	75042	Type CEA-T0	REF		
R27	D5-S2	Res, met flm, 90.9k ±1%, 1/8w	4705-223537	75042	Type CEA-T0	REF		
R28	D3-S3	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	REF		
R29	D3-S4	Res, comp, 47k ±5%, 1/4w	4704-148163	01121	CB4735	REF		
R30	D3-T1	Res, comp, 4.3k ±5%, 1/4w	4704-193375	01121	CB4325	3		
R31	D4-S5	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	3		

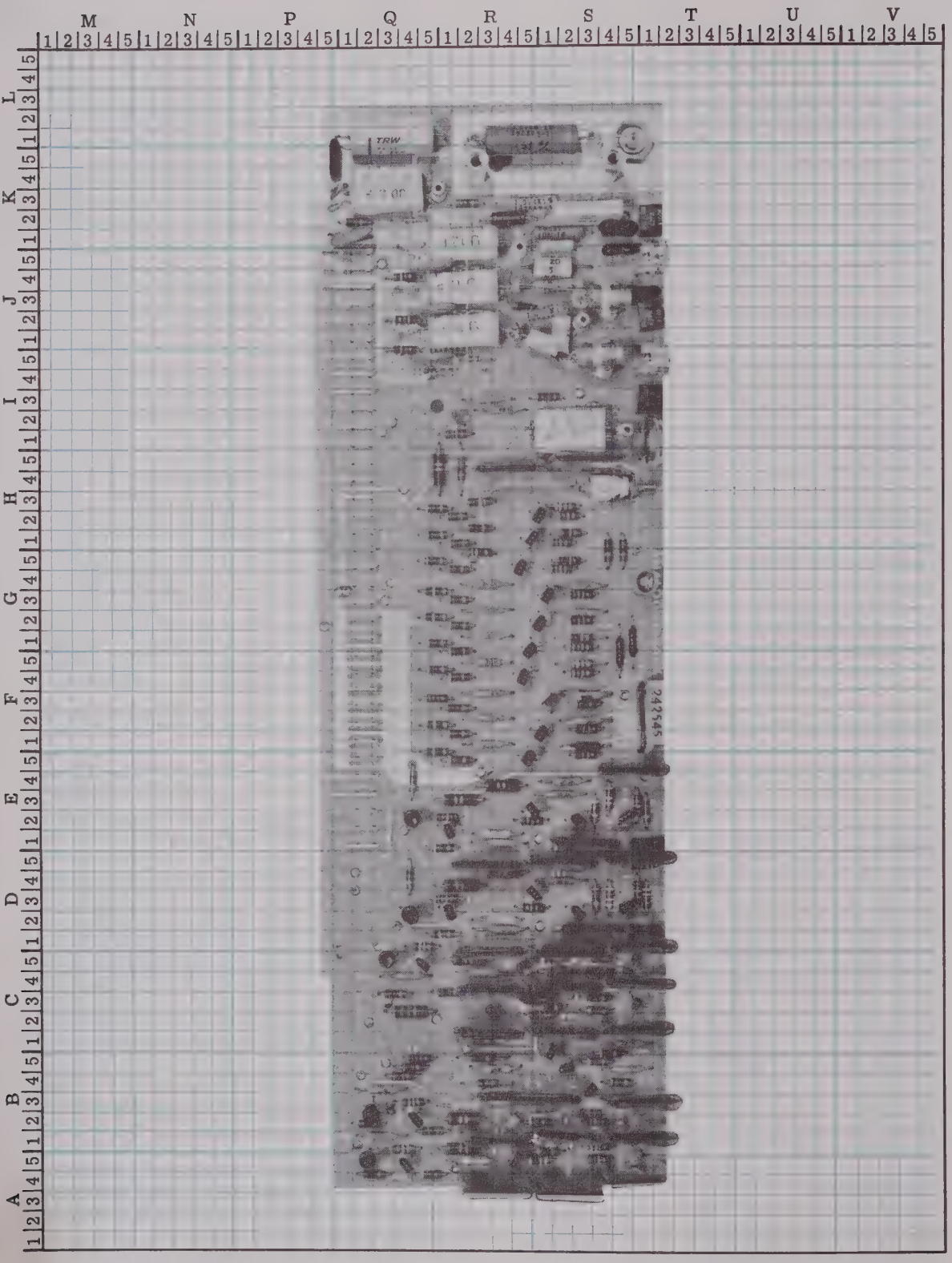


Figure 5-16. ANALOG FEEDBACK P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R32	D4-Q4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R33	C4-T1	Res, ww, 2.5k, matched	10					
R34	C4-S2	Res, ww, 2.5k, matched	10					
R35	C4-R4	Res, ww, 14k, matched	10					
R36	C3-R1	Res, comp, 750Ω ±5%, 1/4w	4704-218024	01121	CB7515	1		
R37	C5-R2	Res, comp, 1Ω ±5%, 1/2w	4704-218693	01121	EB10G5	REF		
R38	C4-Q4	Res, met flm, 16.2k ±1%, 1/8w	4705-226233	75042	Type CEA-T0	REF		
R39	C4-R3	Res, met flm, 30.1k ±1%, 1/8w	4705-168286	75042	Type CEA-T0	REF		
R40	C5-S1	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	REF		
R41	C5-S1	Res, comp, 47k ±5%, 1/4w	4704-148163	01121	CB4735	REF		
R42	C5-S4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R43	C5-S3	Res, comp, 11k ±5%, 1/4w	4704-221580	01121	CB1135	REF		
R44	C3-Q3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R45	C2-S5	Res, ww, 2.5k, matched	10					
R46	C2-S2	Res, ww, 2.5k, matched	10					
R47	C1-R4	Res, ww, 33k, matched	10					
R48	C3-S1	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	13		
R49	C2-S1	Res, comp, 18k ±5%, 1/4w	4704-148122	01121	CB1835	5		
R50	C3-S3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R51	C3-S3	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R52	C2-Q4	Res, comp, 560Ω ±5%, 1/2w	4704-109124	01121	EB5615	1		
R53	A4-S5	Res, ww, 2.5k, matched	10					
R54	A4-S3	Res, ww, 2.5k, matched	10					
R55	A4-R3	Res, ww, 42.5k, matched	10					
R56	A4-Q5	Res, comp, 910Ω ±5%, 1/4w	4704-203851	01121	CB9115	1		
R57	A1-R1	Res, comp, 1Ω ±5%, 1/2w	4704-218693	01121	EB10G5	REF		
R58	B1-Q3	Res, met flm, 16.2k ±1%, 1/8w	4705-226233	75042	Type CEA-T0	REF		
R59	A5-R2	Res, met flm, 30.1k ±1%, 1/8w	4705-168286	75042	Type CEA-T0	REF		
R60	B1-S1	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R61	A5-S1	Res, comp, 47k ±5%, 1/4w	4704-148163	01121	CB4735	REF		
R62	B1-S4	Res, comp, 4.3k ±5%, 1/4w	4704-193375	01121	CB4325	REF		
R63	A5-S4	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R64	A4-Q2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R65	B1-T1	Res, ww, 2.5k, matched	10					
R66	B1-S2	Res, ww, 2.5k, matched	10					
R67	B1-R4	Res, ww, 90k, matched	10					
R68	B2-Q5	Res, comp, 1.8k ±5%, 1/4w	4704-175042	01121	CB1825	2		
R69	B2-R2	Res, comp, 1Ω ±5%, 1/2w	4704-218693	01121	EB10G5	REF		
R70	B4-Q2	Res, met flm, 16.2k ±1%, 1/8w	4705-226233	75042	Type CEA-T0	REF		
R71	B3-R2	Res, met flm, 30.1k ±1%, 1/8w	4705-168286	75042	Type CEA-T0	REF		
R72	B2-S1	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	REF		
R73	B3-S1	Res, comp, 47k ±5%, 1/4w	4704-148163	01121	CB4735	REF		
R74	B2-S4	Res, comp, 4.3k ±5%, 1/4w	4704-193375	01121	CB4325	REF		
R75	B3-S3	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R76	B2-Q2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R77	B3-T1	Res, ww, 10k, matched	10					
R78	B3-R4	Res, ww, 180k, matched	10					
R79	B4-S5	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R80	B4-R3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R81	B4-Q4	Res, comp, 620Ω ±5%, 1/4w	4704-221903	01121	CB6215	2		
R82	B5-S3	Res, met flm, 19.1k ±0.5%, 1/8w	4705-229468	75042	Type CEA	1		
R83	B5-R4	Res, met flm, 361k ±0.1%, 1/8w	4705-229427	75042	Type CEA	1		
R84	B5-S5	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R85	B5-R3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R86	B5-Q4	Res, comp, 620Ω ±5%, 1/4w	4704-221903	01121	CB6215	REF		
R87	C1-S5	Res, met flm, 22.1k ±0.5%, 1/8w	4705-229476	75042	Type CEA	1		
R88	C1-R3	Res, met flm, 453k ±0.1%, 1/8w	4705-229435	75042	Type CEA	1		
R89	C1-S4	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	REF		
R90	C1-R3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R91	B5-Q5	Res, comp, 1.2k ±5%, 1/4w	4704-190371	01121	CB1225	2		
R92	E5-T1	Res, ww, 800Ω, matched	10					
R93	F2-T1	Res, ww, 200Ω, matched	10					
R94	F3-S3	Res, met flm, 169k ±0.1%, 1/8w	4705-229377	75042	Type CEA	1		
R95	F3-R3	Res, met flm, 21k ±0.5%, 1/8w	4705-229484	75042	Type CEA	1		
R96	F3-S3	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	REF		
R97	F3-R2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R98	F3-Q5	Res, comp, 1.2k ±5%, 1/4w	4704-190371	01121	CB1225	REF		
R99	F2-S3	Res, met flm, 361k ±1/4%, 1/8w	4705-229450	75042	Type CEA	1		
R100	F2-R3	Res, met flm, 19.1k ±1%, 1/8w	4705-234963	75042	Type CEA-T0	1		
R101	F2-S3	Res, comp, 18k ±5%, 1/4w	4704-148122	01121	CB1835	REF		
R102	F1-R1	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R103	F2-Q5	Res, comp, 2.4k ±5%, 1/4w	4704-193433	01121	CB2425	4		
R104	F1-S3	Res, met flm, 715k ±0.5%, 1/8w	4705-229500	75042	Type CEA	1		
R105	F1-R3	Res, met flm, 45.3k ±1%, 1/8w	4705-234971	75042	Type CEA-T0	1		
R106	E5-S3	Res, comp, 18k ±5%, 1/4w	4704-148122	01121	CB1835	REF		
R107	E5-R2	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R108	E5-Q5	Res, comp, 2.4k ±5%, 1/4w	4704-193433	01121	CB2425	REF		
R109	G1-S5	Res, met flm, 1.475k, matched	11					
R110	F5-S5	Res, met flm, 30.1Ω, matched	11					
R111	G4-S3	Res, met flm, 10.5k ±1%, 1/8w	4705-234096	75042	Type CEA-T0	1		
R112	G4-R3	Res, met flm, 84.5k ±0.5%, 1/8w	4705-229492	75042	Type CEA	1		
R113	G3-S3	Res, comp, 18k ±5%, 1/4w	4704-148122	01121	CB1835	REF		
R114	G3-R2	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R115	G3-Q5	Res, comp, 2.4k ±5%, 1/4w	4704-193433	01121	CB2425	REF		
R116	G2-S3	Res, met flm, 12.1k ±1%, 1/8w	4705-234997	75042	Type CEA-T0	1		
R117	G2-R3	Res, met flm, 178k ±1%, 1/8w	4705-234989	75042	Type CEA-T0	1		
R118	G2-S3	Res, comp, 18k ±5%, 1/4w	4704-148122	01121	CB1835	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R119	G2-R2	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R120	G2-Q5	Res, comp, 2.4k ±5%, 1/4w	4704-193433	01121	CB2425	REF		
R121	G1-S3	Res, comp, 20k ±5%, 1/4w	4704-221614	01121	CB2035	1		
R122	G1-R3	Res, met flm, 357k ±1%, 1/8w	4705-235002	75042	Type CEA-T0	1		
R123	G1-S3	Res, comp, 36k ±5%, 1/4w	4704-221929	01121	CB3635	5		
R124	F5-R1	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	REF		
R125	G1-Q5	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R126	F5-S3	Res, comp, 39k ±5%, 1/4w	4704-188466	01121	CB3935	2		
R127	F5-R3	Res, met flm, 715k ±1%, 1/8w	4705-236836	75042	Type CEA-T0	1		
R128	F4-S3	Res, comp, 36k ±5%, 1/4w	4704-221929	01121	CB3635	REF		
R129	F4-R2	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	REF		
R130	F5-Q5	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R131	G5-S5	Res, comp, 5.1k ±5%, 1/4w	4704-193342	01121	CB5125	1		
R132	G5-S4	Res, comp, 51Ω ±5%, 1/4w	4704-221879	01121	CB5105	1		
R133	H3-S2	Res, comp, 39k ±5%, 1/4w	4704-188466	01121	CB3935	REF		
R134	H3-R3	Res, comp, 750k ±5%, 1/4w	4704-221937	01121	CB7545	1		
R135	H2-S2	Res, comp, 36k ±5%, 1/4w	4704-221929	01121	CB3635	REF		
R136	H2-R1	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	REF		
R137	H3-Q5	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R138	H1-S2	Res, comp, 82k ±5%, 1/4w	4704-188458	01121	CB8235	1		
R139	H2-R3	Res, comp, 1.5M ±5%, 1/4w	4704-182857	01121	CB1555	1		
R140	H1-S2	Res, comp, 36k ±5%, 1/4w	4704-221929	01121	CB3635	REF		
R141	H1-R2	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	REF		
R142	H1-Q5	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R143	G5-S2	Res, comp, 150k ±5%, 1/4w	4704-182212	01121	CB1545	1		
R144	G5-R3	Res, comp, 3.3M ±5%, 1/4w	4704-208389	01121	CB3355	1		
R145	G5-S2	Res, comp, 36k ±5%, 1/4w	4704-221929	01121	CB3635	REF		
R146	G4-R1	Res, comp, 9.1k ±5%, 1/4w	4704-193318	01121	CB9125	REF		
R147	G5-Q5	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R148	I3-S1	Res, comp, 200Ω ±5%, 1/4w	4704-193482	01121	CB2015	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R149	I3-R3	Res, met flm, 17.4k ±1%, 1/8w	4705-236802	75042	Type CEA-T0	1		
R150	I2-R4	Res, met flm, 68.1k ±1%, 1/8w	4705-236828	75042	Type CEA-T0	1		
R151	H4-S3	Res, met flm, 562k ±1%, 1/8w	4705-235358	75042	Type CEA-T0	1		
R152	H5-R1	Res, comp, 1Ω ±5%, 1/2w	4704-218693	01121	EB10G5	REF		
R153	I1-T1	Res, var, comp, 100k ±30%, 1/4w	4701-223149	71450	Type X201	1		
R154	H5-R2	Res, comp, 1.8k ±5%, 1/4w	4704-175042	01121	CB1825	REF		
R155	H5-R4	Res, ww, 1.797k, matched	10					
R156	H5-S3	Res, ww, 16.625k, matched	10					
R157	J2-R5	Res, met flm, 1.004M, matched	12					
R158	I5-Q4	Res, comp, 180Ω ±5%, 1/4w	4704-147942	01121	CB1815	3		
R159	I3-T1	Res, var, comp, 1k ±30%, 1/2w	4701-203836	73138	Type 62PA	1		
R160	J4-S2	Res, met flm, 100k, matched	12					
R161	J2-Q4	Res, comp, 180Ω ±5%, 1/4w	4704-147942	01121	CB1815	REF		
R162	J2-T1	Res, var, comp, 100Ω ±30%, 1/2w	4701-218107	73138	Type 62PA	1		
R163	K1-S2	Res, met flm, 10k, matched	12					
R164	J4-Q4	Res, comp, 180Ω ±5%, 1/4w	4704-147942	01121	CB1815	REF		
R165	K2-T1	Res, var, comp, 100k ±30%, 1/2w	4701-218099	73138	Type 62PA	1		
R166	K3-S4	Res, met flm, 40.2k ±1%, 1/8w	4705-235333	75042	Type CEA-T0	1		
R167	K3-R5	Res, met flm, 1.014k, matched	12					
R168	K2-Q1	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	1		
R169	L1-R5	Res, met flm, 1.004M, matched	12					
R170	E2-R1	Res, comp, matched to Q31	8					
R171	D3-R1	Res, comp, matched to Q32	8					
R172	D1-Q5	Res, comp, matched to Q33	8					
R173	B1-Q4	Res, comp, matched to Q34	8					
R174	B3-Q4	Res, comp, matched to Q35	8					
R175	E2-R5	Res, comp, matched to Q36	9					
R176	D3-R5	Res, comp, matched to Q37	9					
R177	I1-R1	Res, comp, matched to Q38	9					

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R178	J3-R5	Res, comp, 1M ±5%, 1/4w	4704-182204	01121	CB1055	1		
R179	K3-R2	Res, comp, 22Ω ±5%, 1/4w	4704-147884	01121	CB2205	1		
R180	D5-T1	Res, comp, factory selected	⟩7⟨					
		Shield (not illustrated)	3156-225268	89536	3156-225268	1		

⟩7⟨ C9, C12, C13 and R180 are factory selected. If replacement is required, replace with value indicated on component.

⟩8⟨ Q31/R170, Q32/R171, Q33/R172, Q34/R173, and Q35/R174 are factory matched sets. Resistor values are selected according to the offset voltage of the tested transistors. If replacement is required, order transistor-resistor set, part number 4805-228130.

⟩9⟨ Q36/R175, Q37/R176 and Q38/R177 are factory matched sets. Resistor values are selected according to the offset voltage of the tested transistors. If replacement is required, order transistor-resistor set, part number 4805-228122.

⟩10⟨ These resistors are factory matched. When ordering a replacement, include full reference designation, instrument model and serial number, and all information stamped on the resistor.

⟩11⟨ R109 and R110 are a matched set. For replacement, order part number 4710-229385.

⟩12⟨ R157, R160, R163, R167 and R169 are a matched set. For replacement of one or more resistors, order an entire set, part number 4710-192849.

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A14		**ANALOG AMPLIFIER CIRCUITS P/C ASSEMBLY - Figure 5-17**	1702-226639 (9500A-4014)	89536	1702-226639	REF		
C1	G4-R3	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	6	2	
C2	K3-Q3	Cap, mica, 33 pf ±5%, 500v	1504-160317	88419	CD15E330J	1		
C3	K2-S5	Cap, elect, 125 uf +50/-10%, 16v	1502-186296	73445	C426ARE125	2	1	
C4	K3-Q4	Cap, .mica, 82 pf ±5%, 500v	1504-148502	88419	CD15F820J	1		
C5	L2-Q2	Cap, plstc, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100-K	3		
C6	K5-R2	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	REF		
C7	K5-S1	Cap, mica, 10 pf ±10%, 500v	1504-175216	88419	CD15C0100K	2		
C8	H5-R1	Cap, elect, 640 uf +50/-10%, 6.4v	1502-178608	73445	C437ARC640	2	1	
C9	L2-R2	Cap, plstc, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100-K	REF		
C10	L1-S1	Cap, cer, 1.5 pf ±0.5 pf, 1 kv	1501-178475	80183	10TCCV15NP-O	1		
C11	K3-S3	Cap, plstc, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100-K	REF		
C12	J5-S1	Cap, elect, 50 uf +50/-10%, 25v	1502-168823	73445	C426ARF50	1	1	
C13	J2-R1	Cap, elect, 125 uf +50/-10%, 16v	1502-186296	73445	C426ARE125	REF		
C14	J4-S3	Cap, elect, 80 uf +50/-10%, 16v	1502-192914	73445	C426ARE80	4	1	
C15	I2-S3	Cap, elect, 80 uf +50/-10%, 16v	1502-192914	73445	C426ARE80	REF		
C16	H4-Q5	Cap, elect, 640 uf +50/-10%, 6.4v	1502-178608	73445	C437ARC640	REF		
C17	H5-R3	Cap, elect, 80 uf +50/-10%, 16v	1502-192914	73445	C426ARE80	REF		
C18	H1-S2	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	REF		
C19	G4-S3	Cap, cer, 3.3 pf ±0.5 pf, 1 kv	1501-178483	80183	10TCCV33NP-O	1		
C20	G2-R3	Cap, elect, 80 uf +50/-10%, 16v	1502-192914	73445	C426ARE80	REF		
C21	H4-S1	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	REF		
C22	F1-S3	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	REF		
C23	E5-R5	Cap, cer, 7.5 pf ±10%, 500v	1501-159939	00656	Type C1-1	1		
C24	K1-Q4	Cap, plstc, 0.15 uf ±10%, 100v	1507-222620	88419	DMF1P15	1		
C25	K3-R1	Cap, plstc, 0.22 uf ±20%, 250v	1507-194803	73445	C280AE/P220-K	1		
C26	C4-R3	Cap, cer, 0.001 uf ±20%, 3 kv	1501-105635	80183	29C300	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
C27	G3-S5	Cap, mica, 10 pf ±10%, 500v	1504-175216	88419	CD15C0100K	REF		
C28	D5-S3	Cap, elect, 20 uf +50/-10%, 16v	1502-241356	73445	C426ARE20	2	1	
C29	E1-S1	Cap, elect, 20 uf +50/-10%, 16v	1502-241356	73445	C426ARE20	REF		
C30	E1-Q2	Cap, plstc, 0.022 uf ±10%, 100v	1507-182147	88419	DMF1S22	1		
C31	G1-R3	Cap, plstc, 0.022 uf ±20%, 250v	1507-234484	73445	C280AE/P22K	1		
C32	F1-R2	Cap, elect, 10 uf +50/-10%, 25v	1502-170266	73445	C426ARF10	REF		
C33	E3-S3	Cap, mica, 22 pf ±5%, 500v	1504-148551	88419	CD15E220J	1		
C34	G1-R2	Cap, mica, 220 pf ±5%, 500v	1504-170423	88419	CD15F221J	1		
C35	C4-Q4	Cap, mica, factory selected	13					
C36	C4-R1	Cap, mica, factory selected	13					
CR1	E5-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	7	1	
CR2	E2-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR3	E3-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR4	E2-Q3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR5	C5-R5	Diode, zener, 6.3v, 7.5 ma	4803-172148	03877	1N3496	1	1	
CR6	K3-Q1	Diode, silicon, fast switching	4802-161810	03877	SG5658	2	1	
CR7	K3-Q2	Diode, silicon, fast switching	4802-161810	03877	SG5658	REF		
CR8	D2-R1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR9	E1-Q5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR10	G1-R5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
K1	D4-R1	Relay						
		Switch, dry reed	5103-219097	15898	765972	3		
		Coil, reed relay, 12v	1802-229989	71707	U-12P	1		
K2	D1-R1	Relay						
		Switch, dry reed	5103-219097	15898	765972	REF		
		Switch, dry reed	5103-219097	15898	765972	REF		
		Coil, reed relay, 12v	1802-229971	71707	UD-12P	1		
P1	H4-Q1	Connector, 27 contact	2816-234922	91662	02-027-013-5-200	1		
Q1	J5-R2	Tstr, silicon, PNP	4805-241240	12040	SL214	4	1	
Q2	K1-R3	Tstr, silicon, PNP	4805-241240	12040	SL214	REF		
Q3	K5-Q2	Tstr, Field Effect, N-channel	4805-192864	16856	FN323	1	1	
Q4	L1-R2	Tstr, silicon, PNP	4805-229898	04713	MPS6522	6	1	
Q5	K4-S1	Tstr, silicon, PNP	4805-229898	04713	MPS6522	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q6	K5-S4	Tstr, silicon, PNP	4805-229898	04713	MPS6522	REF		
Q7	J2-S5	Tstr, silicon, PNP	4805-229898	04713	MPS6522	REF		
Q8	I4-R2	Tstr, silicon, NPN	4805-218081	04713	MPS6520	8	1	
Q9	I3-R5	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q10	H5-S1	Tstr, silicon, PNP	4805-229898	04713	MPS6522	REF		
Q11	G5-S2	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q12	G5-R5	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q13	G5-S4	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q14	G4-S2	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q15	F3-R5	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q16	F2-S1	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q17	F1-R5	Tstr, silicon, PNP	4805-229898	04713	MPS6522	REF		
Q18	E4-S1	Tstr, silicon, PNP	4805-195974	04713	2N3906	5	1	
Q19	E4-S2	Tstr, silicon, PNP	4805-195974	04713	2N3906	REF		
Q20	F5-S3	Tstr, silicon, PNP	4805-241240	12040	SL214	REF		
Q21	E1-S4	Tstr, silicon, NPN	4805-218396	04713	2N3904	1	1	
Q22	E3-R4	Tstr, silicon, PNP	4805-195974	04713	2N3906	REF		
Q23	E4-Q3	Tstr, silicon, NPN	4805-168708	03508	2N3391	3	1	
Q24	I4-Q5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q25	E2-R1	Tstr, silicon, PNP	4805-195974	04713	2N3906	REF		
Q26	D4-S2	Tstr, silicon, PNP	4805-241240	12040	SL214	REF		
Q27	E5-Q2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q28	F4-S3	Tstr, silicon, NPN	4805-225607	12040	SL339	1	1	
Q29	D3-R5	Tstr, silicon, PNP	4805-195974	04713	2N3906	REF		
Q30	D3-S1	Tstr, germanium, PNP	4805-182709	01295	GA2877	1	1	
R1	K3-Q2	Res, met flm, 36.5Ω ±1%, 1/8w	4705-168187	75042	Type CEA-T0	1		
R2	K3-Q4	Res, comp, 5.6Ω ±5%, 1/4w	4704-208033	01121	CB56G5	1		
R3	L1-Q4	Res, comp, 560Ω ±5%, 1/4w	4704-147991	01121	CB5615	2		
R4	J4-T1	Res, var, comp, 10k ±30%, 1/4w	4701-223131	71450	Type X201	4		
R5	L1-R4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	10		

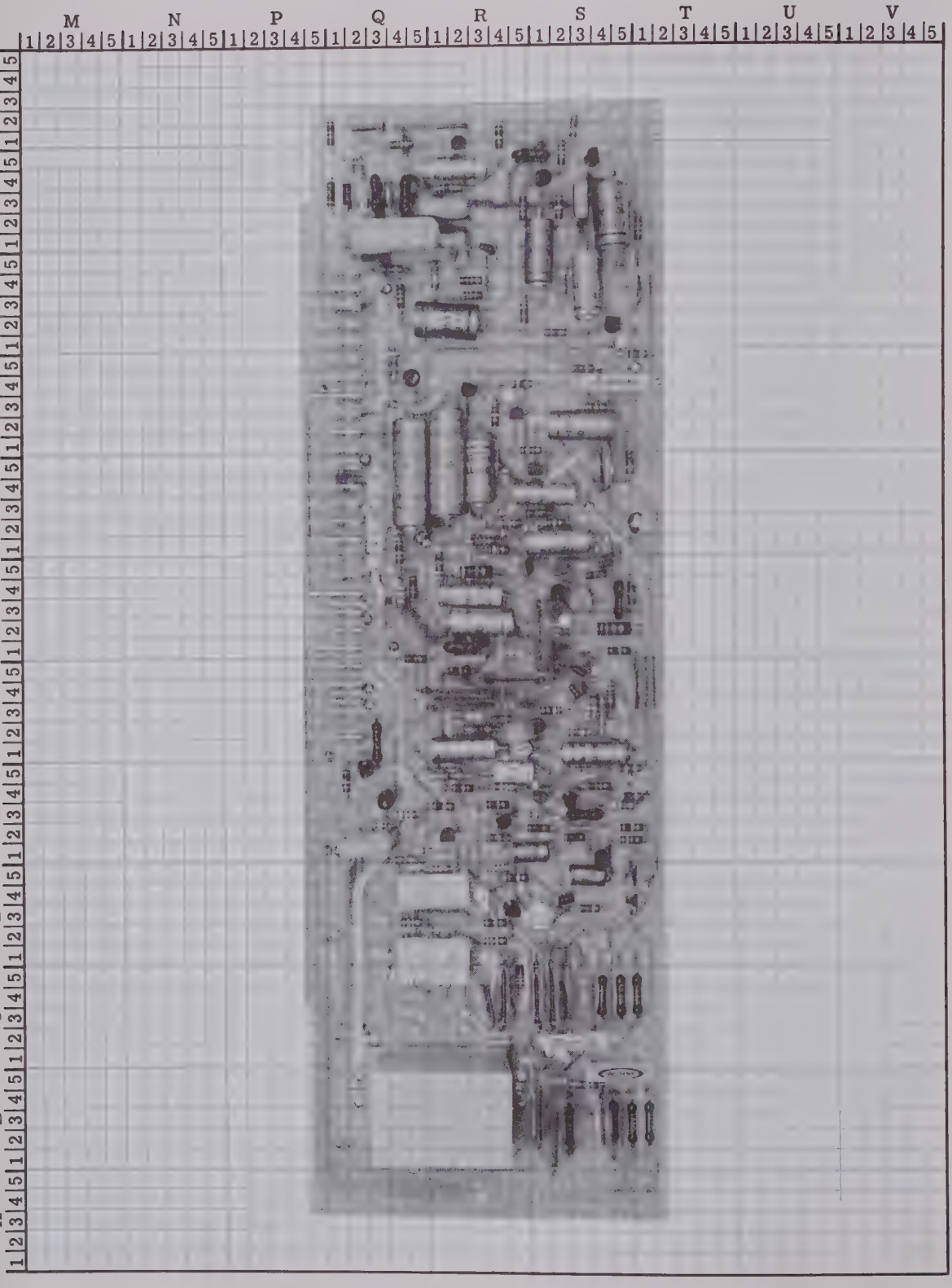


Figure 5-17. ANALOG AMPLIFIER CIRCUITS P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R6	K4-R2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	5		
R7	G5-S4	Res, comp, 2k ±5%, 1/4w	4704-202879	01121	CB2025	2		
R8	K3-R5	Res, comp, 5.6k ±5%, 1/4w	4704-148080	01121	CB5625	4		
R9	L2-S3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	3		
R10	K5-S2	Res, comp, 12k ±5%, 1/4w	4704-159731	01121	CB1235	2		
R11	K3-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R12	J4-S2	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	2		
R13	J3-R5	Res, comp, 1.8k ±5%, 1/4w	4704-175042	01121	CB1825	2		
R14	I5-T1	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	3		
R15	J2-S2	Res, comp, 1.8k ±5%, 1/4w	4704-175042	01121	CB1825	REF		
R16	J3-Q4	Res, comp, 560Ω ±5%, 1/4w	4704-147991	01121	CB5615	REF		
R17	H5-S4	Res, var, comp, 10k ±30%, 1/4w	4701-223131	71450	Type X201	REF		
R18	I4-R5	Res, comp, 3.9M ±5%, 1/4w	4704-188417	01121	CB3955	1		
R19	H5-S5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R20	I3-S4	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	4		
R21	I5-S3	Res, comp, 1.5M ±5%, 1/4w	4704-182857	01121	CB1555	1		
R22	I4-S4	Res, var, ww, 10k ±10%, 1w	4702-190348	02660	3800P-103	2		
R23	H1-Q4	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	3		
R24	I1-S1	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	1		
R25	H2-S2	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R26	H2-R5	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R27	H1-R3	Res, comp, 12k ±5%, 1/4w	4704-159731	01121	CB1235	REF		
R28	G4-S5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	1		
R29	H1-R4	Res, comp, 2.7k ±5%, 1/4w	4704-170720	01121	CB2725	2		
R30	H3-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R31	H2-R4	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	REF		
R32	G2-S5	Res, comp, 620Ω ±5%, 1/2w	4704-108704	01121	EB6215	1		
R33	G5-R3	Res, comp, 750Ω ±5%, 1/2w	4704-108894	01121	EB7515	1		
R34	I3-R4	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R35	H5-R4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R36	D3-S3	Res, comp, 6.2k ±5%, 1/4w	4704-221911	01121	CB6225	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R37	G1-S2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R38	F3-R4	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	2		
R39	F3-S4	Res, comp, 5.1k ±5%, 1/4w	4704-193342	01121	CB5125	1		
R40	F2-S3	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	REF		
R41	F2-R3	Res, comp, 7.5k ±5%, 1/4w	4704-193326	01121	CB7525	2		
R42	F4-S4	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	2		
R43	E5-S5	Res, comp, 2.4k ±5%, 1/4w	4704-193433	01121	CB2425	1		
R44	F4-T1	Res, var, comp, 10k ±30%, 1/4w	4701-223131	71450	Type X201	REF		
R45	E4-R4	Res, comp, 24k ±5%, 1/4w	4704-193425	01121	CB2435	1		
R46	E5-R2	Res, comp, 2k ±5%, 1/4w	4704-202879	01121	CB2025	REF		
R47	E3-S5	Res, comp, 330Ω ±5%, 1/4w	4704-147967	01121	CB3315	1		
R48	E4-S5	Res, comp, 3k ±5%, 1/4w	4704-193508	01121	CB3025	1		
R49	E4-S4	Res, comp, 5.6k ±5%, 1/4w	4704-148080	01121	CB5625	REF		
R50	E2-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R51	E2-S3	Res, comp, 15Ω ±5%, 1/4w	4704-147876	01121	CB1505	2		
R52	E3-R4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R53	F3-R1	Res, ww, 2.5k, matched	14					
R54	G4-Q4	Res, comp, 330k ±5%, 1/4w	4704-192948	01121	CB3345	1		
R55	E2-S5	Res, comp, 2.7k ±5%, 1/4w	4704-170720	01121	CB2725	REF		
R56	E2-R4	Res, comp, 3.6k ±5%, 1/4w	4704-241620	01121	CB3625	1		
R57	F4-R1	Res, ww, 55.2Ω, matched	14					
R58	D3-Q5	Res, comp, 270Ω ±5%, 1/4w	4704-160804	01121	CB2715	1		
R59	E1-Q4	Res, comp, 220Ω ±5%, 1/4w	4704-147959	01121	CB2215	REF		
R60	E3-Q4	Res, comp, 39k ±5%, 1/4w	4704-188466	01121	CB3935	1		
R61	C4-S4	Res, comp, 10Ω ±5%, 1/4w	4704-147868	01121	CB1005	1		
R62	C4-S5	Res, met flm, 20Ω ±1%, 1/8w	4705-236844	75042	Type CEA-T0	1		
R63	C4-T1	Res, met flm, 40.2Ω ±1%, 1/8w	4705-245373	75042	Type CEA-T0	1		
R64	G4-Q5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R65	D4-T1	Res, var, comp, 25k ±30%, 1/4w	4701-233882	71450	Type X201	1		
R66	G5-R1	Res, comp, 47Ω ±5%, 1/4w	4704-147892	01121	CB4705	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R67	F5-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R68	E4-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R69	D5-R1	Res, comp, 33k ±5%, 1/4w	4704-148155	01121	CB3335	3		
R70	E5-R1	Res, comp, 100Ω ±5%, 1/4w	4704-147926	01121	CB1015	REF		
R71	K2-T1	Res, comp, 5.6k ±5%, 1/4w	4704-148080	01121	CB5625	REF		
R72	G1-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R73	L1-Q1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R74	I5-Q4	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R75	C4-S3	Res, met flm, 182k ±1%, 1/8w	4705-241091	75042	Type CEA-T0	1		A
R76	C4-S2	Res, met flm, 150k ±1%, 1/8w	4705-241083	75042	Type CEA-T0	1		A
R77	F4-S4	Res, comp, 8.2k ±5%, 1/4w	4704-160796	01121	CB8225	2		
R78	E2-S1	Res, comp, 15Ω ±5%, 1/4w	4704-147876	01121	CB1505	REF		
R79	J5-Q4	Res, comp, 7.5k ±5%, 1/4w	4704-193326	01121	CB7525	REF		
R80	J4-R1	Res, comp, 11k ±5%, 1/4w	4704-221580	01121	CB1135	1		
R81	J4-R3	Res, comp, 5.6k ±5%, 1/4w	4704-148080	01121	CB5625	REF		
R82	J3-R3	Res, comp, 8.2k ±5%, 1/4w	4704-160796	01121	CB8225	REF		
R83	E3-R1	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	REF		
R85	E5-Q1	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	REF		
R86	F2-Q3	Res, met flm, 1.91k ±1%, 1/8w	4705-236877	75042	Type CEA-T0	1		
R87	C4-Q5	Res, comp, factory selected	13					
R88	C4-R2	Res, comp, factory selected	13					
R89	C4-R4	Res, ww, 146Ω ±0.1%, 1/2w	4707-235432	89536	4707-235432	1		
R90	C2-S3	Res, var, ww, 10k ±10%, 1w	4702-190348	02660	3800P-103	REF		
R91	C3-S2	Res, ww, 36k ±0.1%, 1/2w	4707-239152	89536	4707-239152	1		
R92	B4-S1	Res, ww, 200Ω ±0.1%, 1/2w	4707-235556	89536	4707-235556	2		
R93	C5-S1	Res, ww, 786Ω ±0.1%, 1/2w	4707-235457	89536	4707-235457	1		
R94	B3-S2	Res, met flm, 6.49k ±1%, 1/8w	4705-229419	75042	Type CEA	1		
R95	B1-S2	Res, ww, 1.638k ±0.1%, 1/2w	4707-235440	89536	4707-235440	1		
R96	B5-S5	Res, var, ww, 2k ±10%, 1w	4702-190355	02660	3800P-202	1		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R97	B3-S5	Res, met flm, 84.5Ω ±1%, 1/8w	4705-236851	75042	Type CEA-T0	1		
R98	B3-S5	Res, met flm, 169Ω ±1%, 1/8w	4705-236869	75042	Type CEA-T0	1		
R99	B3-T1	Res, met flm, 340Ω ±1%, 1/8w	4705-229401	75042	Type CEA	1		
R100	B5-S3	Res, comp, 150k ±5%, 1/4w	4704-182212	01121	CB1545	1		
R101	B3-S4	Res, var, comp, 10k ±30%, 1/4w	4701-223131	71450	Type X201	REF		
R102	D5-R5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R103	D5-R4	Res, comp, 33k ±5%, 1/4w	4704-148155	01121	CB3335	REF		
R104	D2-R4	Res, comp, 33k ±5%, 1/4w	4704-148155	01121	CB3335	REF		
R105	D3-R4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R106	F5-R4	Res, ww, 200Ω ±0.1%, 1/2w	4707-235556	89536	4707-235556	REF		
R107	G1-S1	Res, ww, 2.74k, matched	14					
R108	G1-Q5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R109	F3-S2	Res, comp, 820k ±5%, 1/4w	4704-220541	01121	CB8245	1		
TC1 TC2	B3-R3 B3-Q4	Thermocouple, vacuum, matched pair	5302-225524	89536	5302-225524	1		
		Transipad, nylon	3155-152207	17069	88000	1		

13 C35, C36, R87 and R88 are factory selected components and may not be installed. For replacement, replace with exact value.

14 R53, R57 and R107 are a factory matched set. For replacement, replace the entire Thermocouple Amplifier Resistor Set, Part number 4710-228197.

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A15		**NULL DETECTOR P/C ASSEMBLY** Figure 5-18	1702-226647 (9500A-4015)	89536	1702-226647	REF		
C1	K3-S5	Cap, plstc, 0.1 uf ±10%, 50v	1507-150318	56289	194P1049R5	1		
C2	J2-S5	Cap, plstc, 0.1 uf ±20%, 250v	1507-161992	73445	C280AE/P100-K	1		
C3	I3-S4	Cap, Ta, 15 uf ±20%, 6v	1508-161935	56289	196D156X0006	2		
C4	L2-R3	Cap, Ta, 39 uf ±20%, 6v	1508-163915	56289	196D396X0006	1		
C5	K4-R1	Cap, Ta, 15 uf ±20%, 6v	1508-161935	56289	196D156X0006	REF		
C6	J2-R4	Cap, plstc, 0.047 uf ±10%, 50v	1507-150300	56289	194P4739R5	1		
C7	J4-S2	Cap, plstc, 0.22 uf ±20%, 250v	1507-194803	73445	C280AE/P220-K	1		
C8	I4-S1	Cap, plstc, 0.047 uf ±20%, 250v	1507-162008	73445	C280AE/P47K	1		
C9	I1-S5	Cap, Ta, 0.68 uf ±10%, 35v	1508-182790	05397	KR68C35K	1		
C10	F5-S4	Cap, Ta, 68 uf ±10%, 15v	1508-182824	05397	K68C15K	2		
C11	F3-S4	Cap, Ta, 68 uf ±10%, 15v	1508-182824	05397	K68C15K	REF		
C12	H2-R5	Cap, plstc, 0.47 uf ±20%, 250v	1507-184366	73445	C280AE/P470-K	3		
C13	E2-S1	Cap, plstc, 0.47 uf ±20%, 250v	1507-184366	73445	C280AE/P470-K	REF		
C14	B4-Q3	Cap, mica, 3,600 pf ±2%, 500v	1504-176644	88419	CD19G362G	2		
C15	B2-S2	Cap, mica, 3,600 pf ±2%, 500v	1504-176644	88419	CD19G362G	REF		
C16	B4-S1	Cap, mica, 100 pf ±5%, 500v	1504-148494	88419	CD15F101J	2		
C17	B1-Q3	Cap, mica, 100 pf ±5%, 500v	1504-148494	88419	CD15F101J	REF		
C18	B3-Q5	Cap, elect, 125 uf +50/-10%, 16v	1502-186296	73445	C426ARE125	1	1	
C19	C2-S1	Cap, plstc, 0.47 uf 20%, 250v	1507-184366	73445	C280AE/P470-K	REF		
C20	E2-R2	Cap, elect, 20 uf +50/-10%, 16v	1502-241356	73445	C426ARE20	2	1	
C21	D4-Q3	Cap, elect, 20 uf +50/-10%, 16v	1502-241356	73445	C426ARE20	REF		
CR1	K3-R1	Diode, germanium, 80 ma, 35 piv	4802-163907	93332	1N279	1	1	
CR3	D4-R5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	22	3	
CR4	D4-R4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR5	F2-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR6	E5-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR7	E4-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
CR8	E3-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR9	C3-R3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR10	C3-Q5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR11	E5-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR12	F1-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR14	G3-R4	Diode, zener, 5.2v nominal	4803-233627	07910	331686	2	1	
CR15	F1-R4	Diode, zener, 5.2v nominal	4803-233627	07910	331686	REF		
CR16	F5-Q3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR17	F4-Q3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR18	G1-Q3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR19	F4-Q3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR20	F3-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR21	F2-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR22	G2-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR23	G5-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR24	G4-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR25	G5-R4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR26	E5-R4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR27	D2-R3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
P1	G4-Q1	Connector, 27 contact	2816-234922	91662	02-027-013-5-200	1		
Q1	K1-S2	Tstr, silicon, NPN	4805-203489	07910	CDQ10656	2	1	
Q2	L1-S2	Tstr, silicon, NPN	4805-203489	07910	CDQ10656	REF		
Q3	I5-S5	Tstr, silicon, PNP	4805-195974	04713	2N3906	8	1	
Q4	J2-S1	Tstr, silicon, NPN	4805-168708	03508	2N3391	11	2	
Q5	J3-S3	Tstr, silicon, PNP	4805-195974	04713	2N3906	REF		
Q6	I2-S3	Tstr, germanium, NPN	4805-117127	01295	2N1304	1	1	
Q7	H5-S2	Tstr, silicon, dual NPN	4805-220087	03508	12E-1516	3	1	
Q8	H5-S1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q9	I2-S1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q10	G2-S2	Tstr, silicon, PNP	4805-241240	12040	SL214	4	1	

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q11	H4-S1	Tstr, silicon, PNP	4805-195974	04713	2N3906	REF		
Q12	H2-Q5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q13	E5-S2	Tstr, silicon, dual NPN	4805-220087	03508	12E-1516	REF		
Q14	E2-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q15	E1-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q16	E1-S5	Tstr, silicon, PNP	4805-195974	04713	2N3906	REF		
Q17	G5-R1	Tstr, silicon, NPN	4805-222869	03508	X16E2300	2	1	
Q18	E4-R2	Tstr, silicon, NPN	4805-222869	03508	X16E2300	REF		
Q19	D1-S2	Tstr, silicon, dual NPN	4805-220087	03508	12E-1516	REF		
Q20	C4-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q21	C2-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q22	C2-T1	Tstr, silicon, PNP	4805-195974	04713	2N3906	REF		
Q23	D1-Q3	Tstr, silicon, PNP	4805-241240	12040	SL214	REF		
Q24	C1-R2	Tstr, silicon, PNP	4805-195974	04713	2N3906	REF		
Q25	D1-R1	Tstr, silicon, PNP	4805-241240	12040	SL214	REF		
Q26	C1-Q5	Tstr, silicon, PNP	4805-195974	04713	2N3906	REF		
Q27	C1-Q2	Tstr, silicon, PNP	4805-169375	04713	MPS3638	1	1	
Q28	B4-R2	Tstr, silicon, NPN	4805-218081	04713	MPS6520	6	1	
Q29	B1-S1	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q30	B4-R5	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q31	B1-Q5	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q32	B4-R3	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q33	B1-R3	Tstr, silicon, NPN	4805-218081	04713	MPS6520	REF		
Q34	B3-R3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q35	F4-R1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q36	G1-Q5	Tstr, silicon, NPN	4805-159855	07910	CS23030	4	1	
Q37	E5-R1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q38	L2-Q4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q39	G4-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q40	F2-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q41	H5-Q4	Tstr, silicon, PNP	4805-241240	12040	SL214	REF		

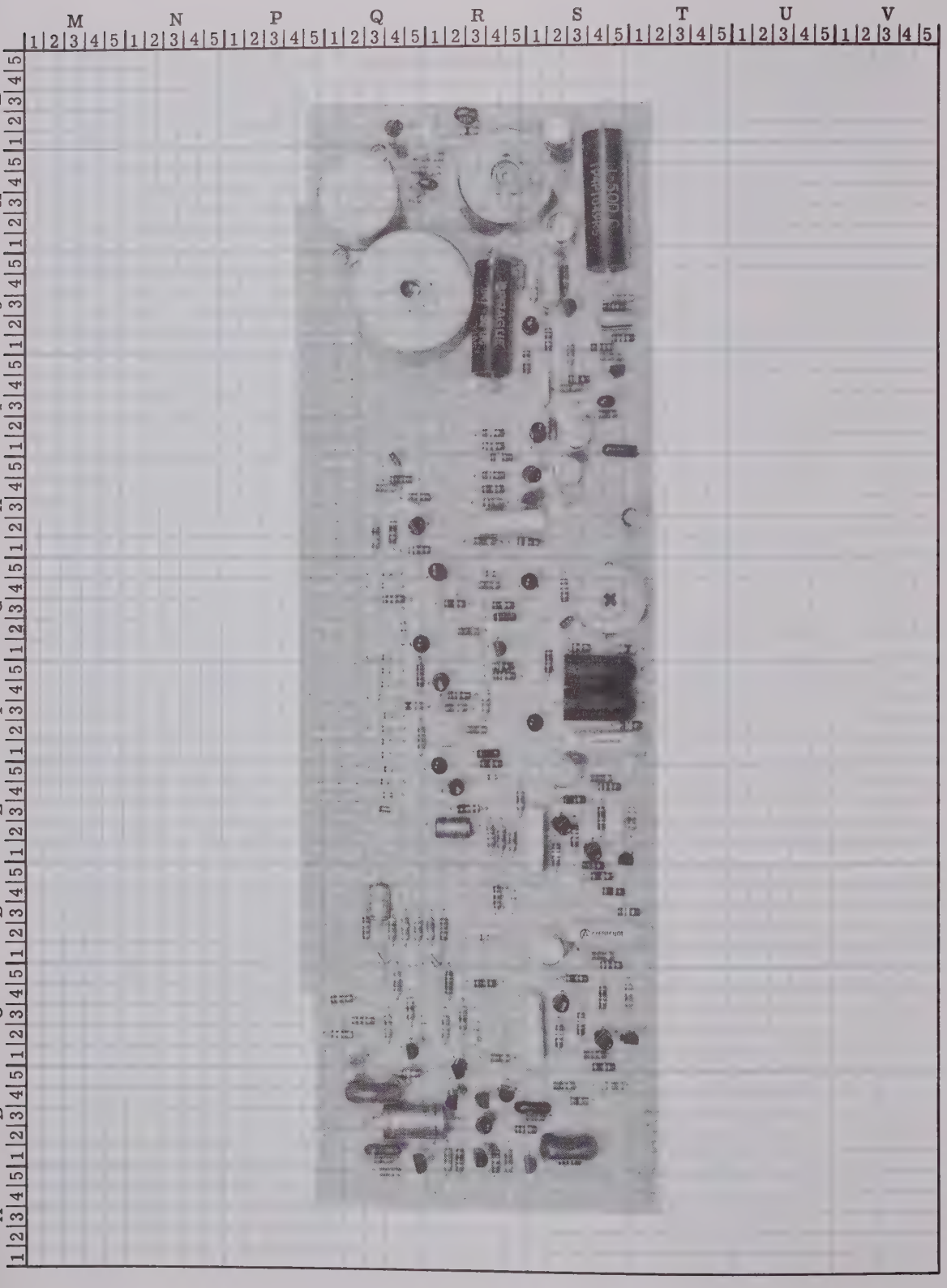


Figure 5-18. NULL DETECTOR P/C ASSEMBLY

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q42	G1-R4	Tstr, silicon, PNP	4805-195974	04713	2N3906	REF		
R1	J3-S5	Res, comp, 200Ω ±5%, 1/4w	4704-147959	01121	CB2215	1		
R2	J3-S5	Res, comp, 5.6k ±5%, 1/4w	4704-148080	01121	CB5625	1		
R3	J1-S4	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	4		
R4	J1-S5	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	8		
R5	I5-S5	Res, comp, 1.8k ±5%, 1/4w	4704-175042	01121	CB1825	1		
R6	I4-S3	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R7	I3-S4	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	6		
R8	K5-R1	Res, comp, 82k ±5%, 1/4w	4704-188458	01121	CB8235	3		
R9	L1-R3	Res, comp, 39Ω ±5%, 1/4w	4704-193391	01121	CB3905	1		
R10	L1-R2	Res, met flm, 22.1Ω ±1%, 1/4w	4705-199943	75042	RN60D22R1F	1		
R11	K4-R1	Res, comp, 120k ±5%, 1/4w	4704-193458	01121	CB1245	2		
R12	J4-S1	Res, comp, 39k ±5%, 1/4w	4704-188466	01121	CB3935	3		
R13	J4-R5	Res, comp, 7.5k ±5%, 1/4w	4704-193326	01121	CB7525	1		
R14	J1-S2	Res, comp, 1.2k ±5%, 1/4w	4704-190371	01121	CB1225	3		
R15	I5-S1	Res, comp, 18k ±5%, 1/4w	4704-148122	01121	CB1835	2		
R16	J4-S2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	4		
R17	J1-S3	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R18	I2-S2	Res, comp, 8.2k ±5%, 1/4w	4704-160796	01121	CB8225	1		
R19	I2-R4	Res, comp, 680k ±5%, 1/4w	4704-188433	01121	CB6845	9		
R20	H5-R4	Res, comp, 680k ±5%, 1/4w	4704-188433	01121	CB6845	REF		
R21	H5-R4	Res, comp, 680k ±5%, 1/4w	4704-188433	01121	CB6845	REF		
R22	G4-S4	Res, var, ww, 10k ±20%, 1 1/4w	4702-112862	71450	Type 110	1		
R23	G1-S5	Res, comp, 33Ω ±5%, 1/4w	4704-175034	01121	CB3305	1		
R24	H4-R4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	8		
R25	I1-R4	Res, comp, 33k ±5%, 1/4w	4704-148155	01121	CB3335	5		
R26	G4-S2	Res, comp, 39k ±5%, 1/4w	4704-188466	01121	CB3935	REF		
R27	G1-S3	Res, comp, 33k ±5%, 1/4w	4704-148155	01121	CB3335	REF		
R28	H3-R4	Res, comp, 430Ω ±5%, 1/4w	4704-203869	01121	CB4315	1		
R29	H1-S1	Res, comp, 390Ω ±5%, 1/4w	4704-147975	01121	CB3915	1		
R30	H1-R3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R31	I4-S3	Res, comp, 1.6M ±5%, 1/4w	4704-218008	01121	CB1655	1		
R32	G1-S2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	7		
R33	E4-R5	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R35	E2-S3	Res, comp, 680k ±5%, 1/4w	4704-188433	01121	CB6845	REF		
R36	E1-S2	Res, comp, 680k ±5%, 1/4w	4704-188433	01121	CB6845	REF		
R37	D5-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R38	E1-S4	Res, comp, 560Ω ±5%, 1/4w	4704-147991	01121	CB5615	4		
R39	F2-S4	Res, var, ww, 2k ±10%, 1w	4702-190355	02660	3800P-202	2		
R40	E5-S4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R41	E4-S3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R42	E3-S4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R43	F2-T1	Res, comp, 680k ±5%, 1/4w	4704-188433	01121	CB6845	REF		
R44	E4-S5	Res, comp, 33k ±5%, 1/4w	4704-148155	01121	CB3335	REF		
R45	E3-T1	Res, comp, 3.9k ±5%, 1/4w	4704-148064	01121	CB3925	4		
R46	E2-R5	Res, comp, 4.7k ±5 %, 1/4w	4704-148072	01121	CB4725	REF		
R47	D4-S5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R48	E2-R4	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R49	D4-R4	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R50	G4-R4	Res, comp, 120Ω ±5%, 1/4w	4704-170712	01121	CB1215	1		
R51	E3-R3	Res, comp, 270Ω ±5%, 1/4w	4704-160804	01121	CB2715	1		
R52	E2-R4	Res, comp, 16k ±5%, 1/4w	4704-221606	01121	CB1635	1		
R53	C3-S3	Res, comp, 680k ±5%, 1/4w	4704-188433	01121	CB6845	REF		
R54	C2-S2	Res, comp, 680k ±5%, 1/4w	4704-188433	01121	CB6845	REF		
R55	C1-S4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R56	C1-S4	Res, comp, 560Ω ±5%, 1/4w	4704-147991	01121	CB5615	REF		
R57	D2-S4	Res, var, ww, 2k ±10%, 1w	4702-190355	02660	3800P-202	REF		
R58	D1-S4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R59	C5-S3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R60	C4-S4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R61	D3-S5	Res, comp, 680k ±5%, 1/4w	4704-188433	01121	CB6845	REF		
R62	C4-T1	Res, comp, 3.9k ±5%, 1/4w	4704-148064	01121	CB3925	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R64	H4-Q3	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	2		
R65	B5-S5	Res, comp, 3.9k ±5%, 1/4w	4704-148064	01121	CB3925	REF		
R66	C5-Q4	Res, comp, 6.2k ±5%, 1/4w	4704-221911	01121	CB6225	1		
R67	C3-R2	Res, comp, 47Ω ±5%, 1/4w	4704-147892	01121	CB4705	4		
R68	D2-Q4	Res, comp, 2.4k ±5%, 1/4w	4704-193433	01121	CB2425	1		
R69	D2-Q4	Res, comp, 3k ±5%, 1/4w	4704-193508	01121	CB3025	2		
R70	D2-Q2	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R71	C3-R1	Res, comp, 82k ±5%, 1/4w	4704-188458	01121	CB8235	REF		
R72	C5-R2	Res, comp, 1.2k ±5%, 1/4w	4704-190371	01121	CB1225	REF		
R73	C4-Q5	Res, comp, 47Ω ±5%, 1/4w	4704-147892	01121	CB4705	REF		
R74	C3-Q4	Res, comp, 82k ±5%, 1/4w	4704-188458	01121	CB8235	REF		
R75	D2-R1	Res, comp, 1.2k ±5%, 1/4w	4704-190371	01121	CB1225	REF		
R76	D2-R1	Res, comp, 1.5k ±5%, 1/4w	4704-148031	01121	CB1525	5		
R77	D2-Q5	Res, comp, 3.3k ±5%, 1/4w	4704-148056	01121	CB3325	1		
R78	C4-Q1	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R79	C2-Q1	Res, comp, 3.9k ±5%, 1/4w	4704-148064	01121	CB3925	REF		
R80	C3-Q2	Res, comp, 18k ±5%, 1/4w	4704-148122	01121	CB1835	REF		
R81	C5-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R82	F3-Q5	Res, comp, 30k ±5%, 1/4w	4704-193417	01121	CB3035	1		
R83	F3-R2	Res, comp, 120k ±5%, 1/4w	4704-193458	01121	CB1245	REF		
R84	F4-R2	Res, comp, 12k ±5%, 1/4w	4704-159731	01121	CB1235	2		
R85	F5-Q5	Res, comp, 560Ω ±5%, 1/4w	4704-147991	01121	CB5615	REF		
R86	G2-R3	Res, comp, 1.5k ±5%, 1/4w	4704-148031	01121	CB1525	REF		
R87	G3-R4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R88	F2-Q5	Res, comp, 560Ω ±5%, 1/4w	4704-147991	01121	CB5615	REF		
R89	F2-R3	Res, comp, 1.5k ±5%, 1/4w	4704-148031	01121	CB1525	REF		
R90	E5-R4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R91	H1-Q5	Res, comp, 4.3k ±5%, 1/4w	4704-193375	01121	CB4325	1		
R92	H2-Q4	Res, comp, 3k ±5%, 1/4w	4704-193508	01121	CB3025	REF		
R93	H4-Q5	Res, comp, 12k ±5%, 1/4w	4704-159731	01121	CB1235	REF		
R94	B5-Q5	Res, comp, 22k ±5%, 1/4w	4704-148130	01120	CB2235	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R95	B5-S2	Res, comp, 22M ±5%, 1/4w	4704-221986	01121	CB2265	2		
R96	A5-Q4	Res, comp, 22M ±5%, 1/4w	4704-221986	01121	CB2265	REF		
R97	B1-S3	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R98	B3-S1	Res, comp, 470Ω ±5%, 1/4w	4704-147983	01121	CB4715	REF		
R99	B3-R5	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R100	B4-S3	Res, comp, 47Ω ±5%, 1/4w	4704-147892	01121	CB4705	REF		
R101	B1-Q3	Res, comp, 47Ω ±5%, 1/4w	4704-147892	01121	CB4705	REF		
R102	B1-R2	Res, comp, 1.5k ±5%, 1/4w	4704-148031	01121	CB1525	REF		
R103	B1-R5	Res, comp, 1.5k ±5%, 1/4w	4704-148031	01121	CB1525	REF		
R104	B1-R2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R105	B1-R4	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R106	D1-S5	Res, comp, 33k ±5%, 1/4w	4704-148155	01121	CB3335	REF		
R107	C1-R4	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R108	F5-R4	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R109	F5-R4	Res, comp, 22k ±5%, 1/4w	4704-148130	01121	CB2235	REF		
R110	G3-Q4	Res, comp, 33k ±5%, 1/4w	4704-148155	01121	CB3335	REF		
R111	F3-R3	Res, comp, 39k ±5%, 1/4w	4704-188466	01121	CB3935	REF		
R112	H2-Q3	Res, comp, 100k ±5%, 1/4w	4704-148189	01121	CB1045	1		
R113	H4-Q4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R114	G3-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
T1	K4-R4	Transformer, oscillator	1800-197970	89536	1800-197970	1		
T2	J3-Q5	Transformer, RF	5602-228148	89536	5602-228148	1		
T3	K3-Q2	Modulator	5602-228155	89536	5602-228155	1		
	B2-T1	Jumper, shorting	6002-239285	89536	6002-239285	1		
		Transipad, nylon	3155-152207	17069	88000	3		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
A16		**MOTHER BOARD P/C ASSEMBLY Figure 5-19**	1702-226654 (9500A-4016)	89536	1702-226654	REF		
R1	J2-P1	Res, comp, 470Ω ±5%, 1/2w	4704-108787	01121	EB4715	1		
XA1	F5-U4	Connector, 22 contact	2816-233742	91662	02-22-115-3-200	2		
XA2	F5-U1	Connector, 18 contact	2816-235010	91662	02-018-115-3-200	1		
XA3	K4-P5	Connector, 32 contact	2816-235036	91662	02-032-115-3-200	3		
XA4	K1-P5	Connector, 32 contact	2816-235036	91662	02-032-115-3-200	REF		
XA5	J3-P5	Connector, 32 contact	2816-235036	91662	02-032-115-3-200	REF		
XA6	I5-P5	Connector, 27 contact	2816-235028	91662	02-027-115-3-200	8		
XA7	I2-P5	Connector, 27 contact	2816-235028	91662	02-027-115-3-200	REF		
XA8	H4-P5	Connector, 27 contact	2816-235028	91662	02-027-115-3-200	REF		
XA9	H1-P5	Connector, 27 contact	2816-235028	91662	02-027-115-3-200	REF		
XA10	G3-P5	Connector, 27 contact	2816-235028	91662	02-027-115-3-200	REF		
XA11	F5-P5	Connector, 22 contact	2816-233742	91662	02-22-115-3-200	REF		
XA12	F2-P5	Connector, 27 contact	2816-235028	91662	02-027-115-3-200	REF		
XA13	D4-Q3	Connector, 35 contact	2816-235044	91662	02-035-115-3-200	1		
XA14	C3-Q3	Connector, 27 contact	2816-235028	91662	02-027-115-3-200	REF		
XA15	B2-Q3	Connector, 27 contact	2816-235028	91662	02-027-115-3-200	REF		

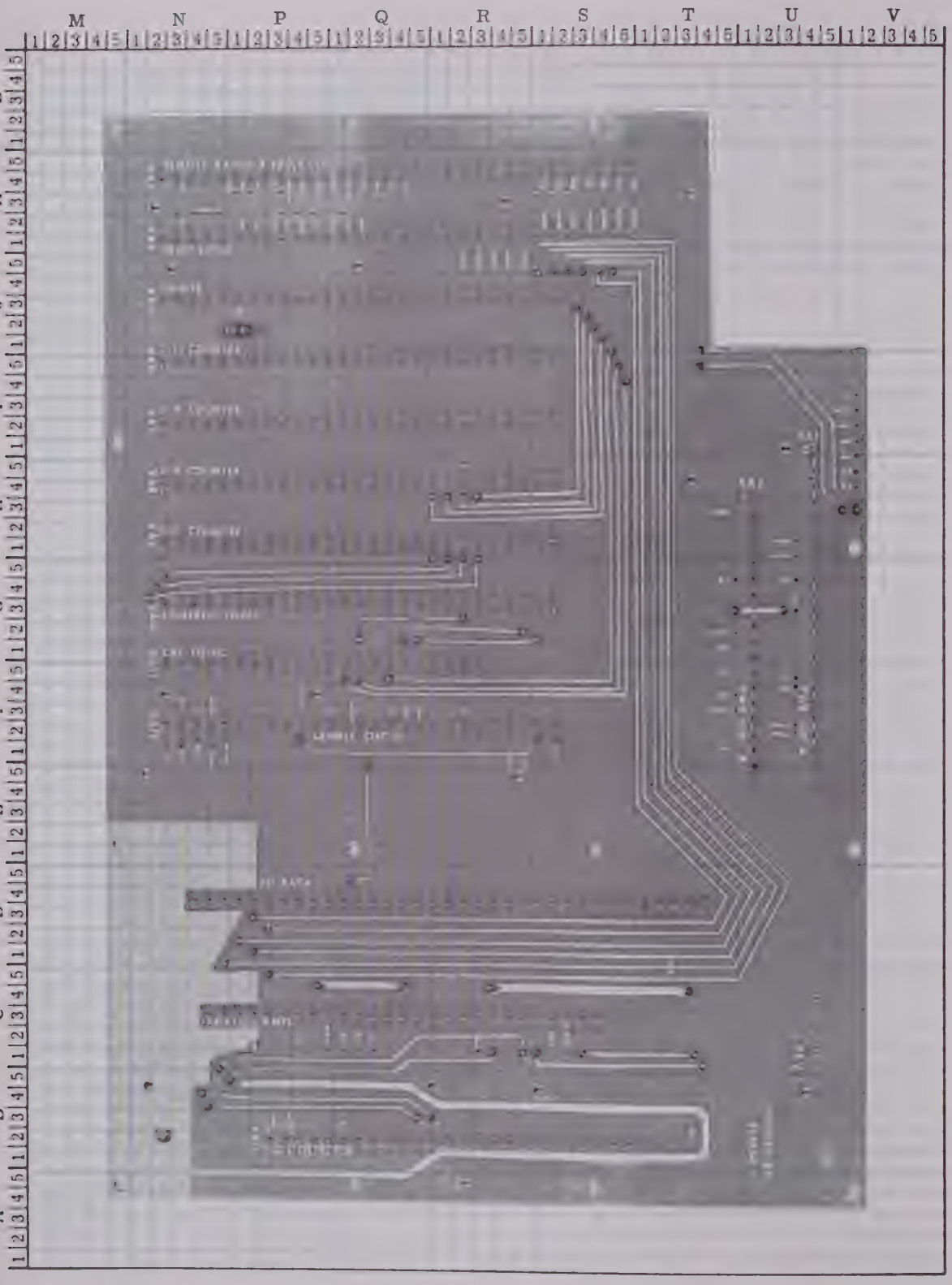


Figure 5-19. MOTHER BOARD P/C ASSEMBLY

5-9. SERIAL NUMBER EFFECTIVITY

5-10. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the Model 9500A. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List below. All parts with no code are used on all instruments with serial numbers above 123.

USE CODE	EFFECTIVITY
NO CODE	Model 9500A, serial number 123 and on.
A	Model 9500A, serial number 123 thru 147.
B	Model 9500A, serial number 148 and on.
C	Model 9500A, serial number 123 thru 262 and 273 thru 343.
D	Model 9500A, serial number 263 thru 272 and 344 and on.

SECTION VI

ACCESSORY AND OPTION INFORMATION

6-1. INTRODUCTION

6-2. This section of the manual contains information pertaining to the accessories and options available for your instrument.

6-3. ACCESSORY INFORMATION

6-4. The accessory information, if applicable, will contain details concerning accessories that may be used with this particular instrument.

6-5. OPTION INFORMATION

6-6. Each of the options available for this instrument, if any, are described separately under headings containing the option number. The option descriptions contain applicable operating and maintenance instructions and in most cases, field installation procedures. A complete list of replaceable parts for each option is contained at the end of the option description.

OPTION INFORMATION

PROBE INPUT (OPTION - 01) FOR THE MODEL 9500A RMS DIGITAL VOLTMETER

6-1. INTRODUCTION

6-2. The Model 9500A can be equipped with a probe input upon installation of the 9500A-701 Option Kit. Upon installation of this kit, the instrument is identified as a Model 9500A-01 on its rear panel decal.

6-3. OPERATING PROCEDURES

6-4. Operation of the instrument with a probe input involves attaching the short ground clip of the probe to a common circuit point and then sampling the circuit voltage with the probe tip. Applicable operating instructions are contained in Section II of the Model 9500A manual.

6-5. CIRCUIT DESCRIPTION

6-6. Whenever the probe assembly is installed in the instrument, the input attenuator network A13R169 and A13C6 is located in the probe assembly. The range feedback network resistors are then matched to the probe assembly and A13C23 is removed from the instrument to compensate for the added cable capacity. Input capacitance of the probe is less than 7 pf.

6-7. MAINTENANCE INSTRUCTIONS

6-8. Troubleshooting and calibration of the instrument with a probe input remains the same as the basic Model 9500A. Applicable maintenance instructions are contained in Section IV of the Model 9500A manual. A complete list of parts contained in the 9500A-701 Option Kit is located at the rear of this Option Information section.

6-9. FIELD INSTALLATION INSTRUCTIONS

6-10. To install the 9500A-701 Option Kit components in the Model 9500A, proceed as follows:

a. Remove the top inner and outer covers from the instrument.

b. Remove the A13 Analog Feedback Circuits assembly from the instrument.

c. Remove C23, R157, R160, R163, R167, and R169 from the A13 assembly.

d. Install the resistors contained in the 9500A-701 Option Kit in their corresponding A13 assembly positions.

e. Remove the front panel BNC input connector and install in its place the probe cable connector contained in the 9500A-701 Option Kit.

f. Attach the probe assembly to the connector installed in step e and install the A13 assembly in the instrument.

g. Place an X on the rear panel decal adjacent to the PROBE INPUT -01.

h. Calibrate the Model 9500A-01 using the procedures described in Section IV of the Model 9500A manual.

6-11. PARTS LIST

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		RMS DIGITAL VOLTMETER - Probe Input Option	9500A-01					
		NOTE: The basic Model 9500A can be modified in the field by installing the Probe Option Kit, part number 9500A-701. The kit includes the probe, probe cable, connector plug, R157, R160, R163, and R167. Instructions for installing the option kit are given in the preceding text.						
A13		Analog Feedback P/C Assembly	1702-242552 (9500A-4024)	89536	1702-242552	1		
		Probe Assembly ▷1	2906-239756	89536	2906-239756	1		
C6		Cap, cer, 5.6 pf, matched pair (inside probe)	1501-220574	89536	1501-220574	1		
R157		Res, met flm, 1.004M, matched	▷1					
R160		Res, met flm, 100k, matched	▷1					
R163		Res, met flm, 10k, matched	▷1					
R167		Res, met flm, 1.014k, matched	▷1					
R169		Res, met flm, 1.004M, matched (inside probe)	▷1					
		Cable, probe	6008-239699	89536	6008-239699	1		
		Plug, connector	3153-203117	89536	3153-203117	1		
		NOTE: All other components are the same as the A13 assembly in the basic 9500A.						

▷1 R157, R160, R163, R167, R169 and the probe are a matched set. For replacement of these resistors or the probe, order part number 2906-239756 which includes the probe and the resistors.

OPTION INFORMATION

REAR PANEL BNC INPUT (OPTION - 02)

FOR THE MODEL 9500A RMS DIGITAL VOLTMETER

6-1. INTRODUCTION

6-2. The Model 9500A can be equipped with a rear panel BNC input upon installation of the 9500A-702 Option Kit. Upon installation of this kit, the instrument is identified as a Model 9500A-02 on its rear panel decal.

6-3. OPERATING PROCEDURES

6-4. Operation of the instrument with a rear panel BNC input is identical to that of the Model 9500A with the only difference being the location of the input connector. Applicable operating instructions are contained in Section II of the Model 9500A manual.

6-5. CIRCUIT DESCRIPTION

6-6. Circuitry of the Model 9500A-02 is identical to that of the Model 9500A.

6-7. MAINTENANCE INSTRUCTIONS

6-8. Troubleshooting and calibration of the instrument with a rear panel BNC input remains the same as the basic Model 9500A. Applicable maintenance instructions are contained in Section IV of the Model 9500A manual. A list of parts contained in the 9500A-702 Option Kit is located at the rear of this Option Information section.

6-9. FIELD INSTALLATION INSTRUCTIONS

6-10. To install the 9500A-702 Option Kit components in the Model 9500A, proceed as follows:

a. Remove the top inner and outer covers from the instrument.

b. Remove the A13 through A15 assemblies from the instrument.

c. Remove the front panel BNC input connector and cable assembly from the instrument.

d. Install the snap-button contained in the option kit in the front panel input hole.

e. Remove the rear panel snap-button and install the BNC connector contained in the option kit in the rear panel hole.

f. Install the cable assembly contained in the option kit in the Model 9500A, routing the cable assembly between the A14 and A15 assembly positions.

g. Install the panduit ties contained in the option kit to secure the cable assembly to the instrument.

h. Solder the inner conductor and shield of the cable assembly to the center pin and outer shell of the rear panel BNC connector.

i. Install the A13 through A15 assemblies in the instrument and connect the cable assembly to the A13 assembly.

j. Place an X on the rear panel decal adjacent to the REAR BNC -02.

k. Calibrate the Model 9500A -02 using the procedures described in Section IV of the Model 9500A manual.

6-11. PARTS LIST

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		RMS DIGITAL VOLTMETER - Rear BNC Input Option	9500A-02					
		NOTE: The basic Model 9500A can be modified in the field by installing the Rear Panel BNC Input Kit, part number 9500A-702. The kit includes the connector, plug button and the cable assembly. Instructions for installing the option kit are given in the preceding text.						
		Cable Assembly	6002-239442	89536	6002-239442	1		
		Connector, female, BNC	2106-144667	02660	UG290A/U	1		
		Plug button, snap, 1/2"	2109-101774	83330	653	1		

OPTION INFORMATION

PRINTER OUTPUT AND REMOTE RANGING (OPTIONS -03 AND -04) FOR THE MODEL 9500A RMS DIGITAL VOLTMETER

6-1. INTRODUCTION

6-2. The Model 9500A can be equipped to provide a coded printer output along with a remote ranging capability upon installation of either the 9500A-703 or 9500A-704 Option Kit. A 1-2-4-8 BCD coded printer output is provided by the 9500A-703 Option Kit while a 1-2-2*4 BCD coded printer output is provided by the 9500A-704 Option Kit. Choice of either option kit depends solely on the input requirements of the external printer. Upon installation of the 9500A-703 or 9500A-704 Option Kit, the instrument is identified as a Model 9500A-03 or -04 on its rear panel decal.

6-3. The printer outputs supply data and range outputs and the print command necessary to gate the external printer. Figure 1 illustrates the logic levels and equivalent output circuitry.

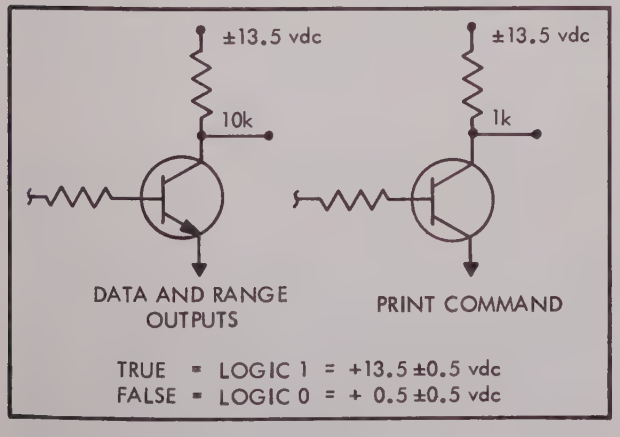


Figure 1. PRINTER OUTPUTS

6-4. OPERATING PROCEDURES

6-5. PRINTER OPERATION

6-6. Operation of the instrument while driving a printer involves connecting the printer input cable to the Model 9500A rear panel output connector. The Model 9500A readout is then automatically transferred to the printer in the appropriate code at the end of each sample period. A mating connector for the rear panel output connector is supplied with each option kit. Figure 2 illustrates each pin function of the mating connector.

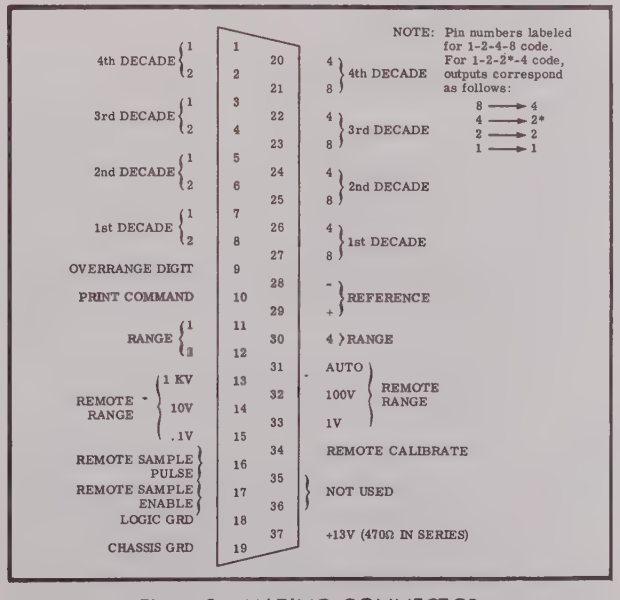

NOTE: Pin numbers labeled for 1-2-4-8 code. For 1-2-2*-4 code, outputs correspond as follows:
8 → 4
4 → 2*
2 → 2
1 → 1
4th DECADE 1 2
3rd DECADE 1 2
2nd DECADE 1 2
1st DECADE 1 2
OVERRANGE DIGIT
PRINT COMMAND
RANGE 1 2
REMOTE RANGE 1 KV 10V .1V
REMOTE SAMPLE PULSE
REMOTE SAMPLE ENABLE
LOGIC GRD
CHASSIS GRD
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37
4 8 4th DECADE
4 8 3rd DECADE
4 8 2nd DECADE
4 8 1st DECADE
- + REFERENCE
4 RANGE
AUTO 100V 1V REMOTE RANGE
REMOTE CALIBRATE
NOT USED
+13V (470Ω IN SERIES)

Figure 2. MATING CONNECTOR

6-7. Decade readout data is available in two coding groups of 1-2-4-8 or 1-2-2*-4. Figure 3 lists the two readout codes and their corresponding digit value.

DIGIT VALUE	CODE					DIGIT VALUE	CODE				
	O/R	8	4	2	1		O/R	4	2*	2	1
0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	1	1	0	0	0	0	1
2	0	0	0	1	0	2	0	0	0	1	0
3	0	0	0	1	1	3	0	0	0	1	1
4	0	0	1	0	0	4	0	0	1	1	0
5	0	0	1	0	1	5	0	0	1	1	1
6	0	0	1	1	0	6	0	1	1	0	0
7	0	0	1	1	1	7	0	1	1	0	1
8	0	1	0	0	0	8	0	1	1	1	0
9	0	1	0	0	1	9	0	1	1	1	1
10	1	0	0	0	0	10	1	0	0	0	0
11	1	0	0	0	1	11	1	0	0	0	1

Figure 3. PRINTER OUTPUT DECADE CODING

6-8. A 1-2-4 BCD output, available at terminals 11, 12, and 30 of the rear panel connector, represents a decimal value for each range the instrument readout is being sampled. Figure 4 list the range coding.

RANGE	PIN 30	PIN 12	PIN 11
	4	2	1
0.1	0	0	0
1	0	0	1
10	0	1	0
100	0	1	1
1000	1	0	0

Figure 4. PRINTER OUTPUT RANGE CODING

6-9. REMOTE CONTROL

6-10. Remote control of the sample rate and self-calibration feature is provided with each instrument. Installation of either printer option provides the capability of remote range control. Remote control of these features is actuated by applying +3 to +20 volts dc to the appropriate rear panel connector terminal or terminals illustrated in Figure 5. Equivalent remote input circuits and the remote logic levels are illustrated in Figure 6.

6-11. REMOTE SAMPLE RATE CONTROL

6-12. Two remote control signal inputs are necessary to allow remote control of the sample rate. A continuous enable signal of +3 to +20 volts dc must be applied to terminal 17 of the rear panel connector to enable the remote sample generator and disable the sample pulse generator. A remote sample pulse, such as the one illustrated in Figure 7, must then be applied to terminal 16 each time a readout is required. This remote sample

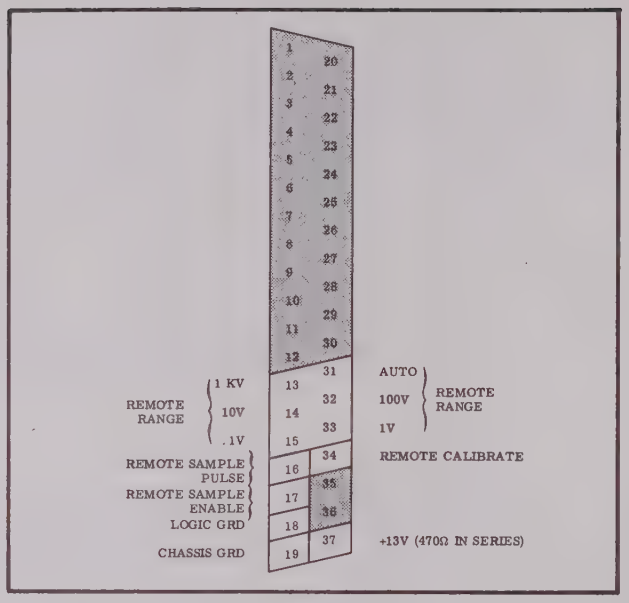


Figure 5. REMOTE CONTROL INPUT TERMINALS

pulse can be either a positive going 10 microsecond pulse (logic 0 to logic 1 and return), a negative going 10 microsecond pulse (logic 1 to logic 0 and return), or a positive going 100 microsecond squarewave having a 50% duty cycle. Transfer of data then occurs at the beginning of the positive transition time of the signal. Whenever the sample rate is remotely controlled, the automatic self-calibration feature is disabled. Self-calibration of the instrument must then be manually

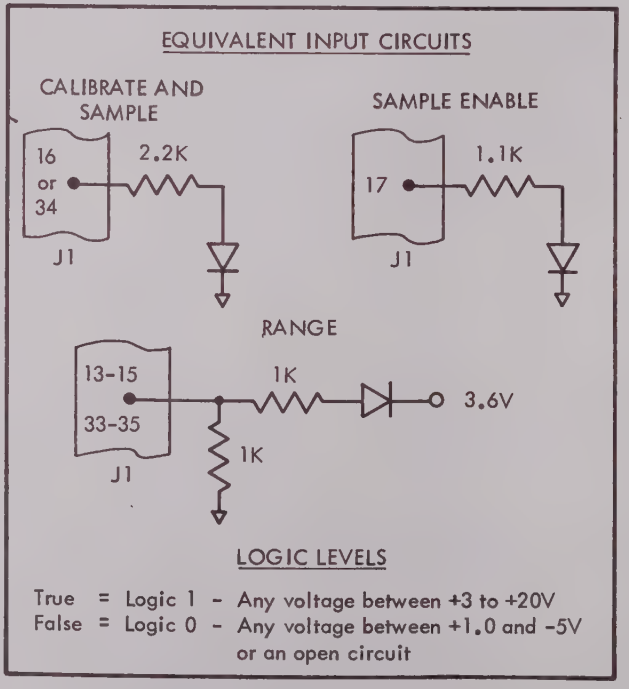


Figure 6. REMOTE CONTROL INPUTS

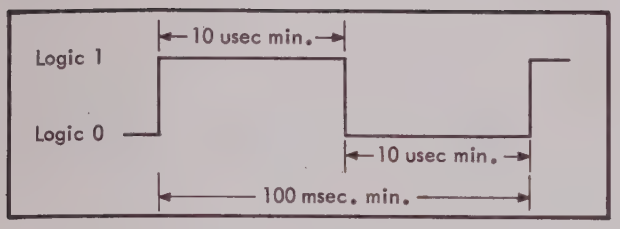


Figure 7. REMOTE SAMPLE SIGNAL

accomplished from the front panel or remotely in the manner described in paragraphs 6-13 and 6-14.

6-13. REMOTE SELF-CALIBRATE CONTROL

6-14. The self-calibration cycle of the Model 9500A can be remotely initiated upon application of a +3 to +20 volt dc command to terminal 34 of the rear panel. The worst possible thermocouple unbalance can be corrected with a remote calibration command of 25 seconds. If the instrument has been operated for 24 hours without self-calibration, a 15 second calibration command will correct any thermocouple unbalance. If the instrument is measuring a steady input signal, a one second calibration command on a five to ten minute cycle may be used. However, a five second calibration command on a ten minute cycle will handle any measurement condition.

6-15. REMOTE RANGE CONTROL

6-16. Installation of either Printer Output Option provides the capability for remote control of range, thus providing complete remote control capabilities for the Model 9500A. Application of a 3 to 20 volt dc range command to the rear panel connector terminals listed in Figure 8 will override the front panel RANGE control and select the corresponding voltage range of the Model 9500A.

TERMINAL	RANGE
15	.1
33	1
14	10
32	100
13	1000
31	AUTO

Figure 8. REMOTE RANGING TERMINALS

6-17. CIRCUIT DESCRIPTION

6-18. The BCD outputs of the Decade Counters and Range Logic assemblies are applied to the rear panel output connector through the optional A3 and A4 Printer Output assemblies. The 1-2-4-8 Printer Output assemblies consist of inverter-drivers that furnish output data in a 1-2-4-8 BCD form. The 1-2-2*4 Printer Output assemblies include NAND gates along with inverter-drivers to convert the input 1-2-4-8 code from the instrument into the 1-2-2*4 BCD output form. Output coding is illustrated in Figure 3.

6-19. FIELD INSTALLATION INSTRUCTIONS

6-20. To install either the 9500A-703 or 704 Option Kits, proceed as follows:

a. Remove the top outer and inner covers from the Model 9500A.

b. Remove the jumper from between terminals 28 and 30 of the A3 motherboard assembly connector.

c. Install the A3 and A4 assemblies in their respective positions in the Model 9500A. Refer to Figure 9 for the correct positions.

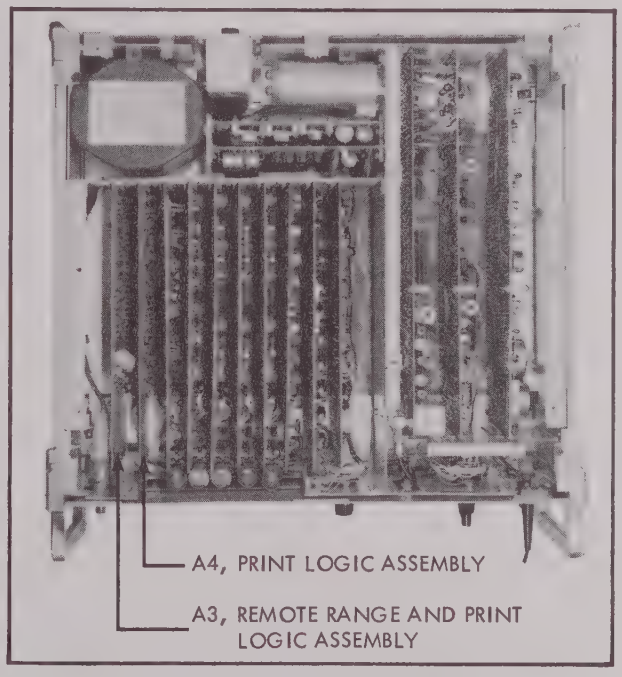


Figure 9. PRINTER OUTPUT ASSEMBLY LOCATIONS

d. Replace the top inner and outer covers on the instrument.

e. Connect the mating connector included with the option kit to the printer cable. Refer to Figure 2 for pin functions of the mating connector.

f. Connect the printer cable using the mating connector supplied in the option kit to the Model 9500A rear panel connector.

g. Place an X on the rear panel decal adjacent to the corresponding 03 or 04 option installed in the instrument.

h. Operation of the printer outputs can be verified using the operating procedures described in paragraph 6-4 and Section II of the Model 9500A manual.

6-21. PARTS LIST

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		RMS DIGITAL VOLTMETER - 8421 Code Option NOTE: The basic Model 9500A can be modified in the field by installing the 8421 Print Option Kit, part number 3158-239764. The kit includes P1 and the A3 and A4 P/C assemblies. Instructions for installing the option kit are given in the preceding text.	9500A-03					
A3		Remote Range and Print Logic P/C Assembly - 8421 Code Option (See Figure 10)	1702-228445 (9500A-4021)	89536	1702-228445	1		
A4		Print Logic P/C Assembly - 8421 Code Option (See Figure 11)	1702-228452 (9500A-4022)	89536	1702-228452	1		
P1		Connector, male, 37 contact	2105-235093	71785	DC37P	1		
A3		REMOTE RANGE AND PRINT LOGIC P/C ASSEMBLY - 8421 CODE OPTION - Figure 10	1702-228445 (9500A-4021)	89536	1702-228445	REF		
C1	J5-T1	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	6		
C2	J5-S3	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C3	J5-R4	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C4	J5-R1	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C5	K1-Q2	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C6	K4-P4	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
CR1	K4-Q1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	6	2	
CR2	K4-T2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR3	K4-S4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR4	K4-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR5	K4-R2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR6	K4-Q4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR7	I1-Q1	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	1	1	
P1	H2-P4	Connector, 32 contact	2816-234930	91662	02-032-013-5-200	1		

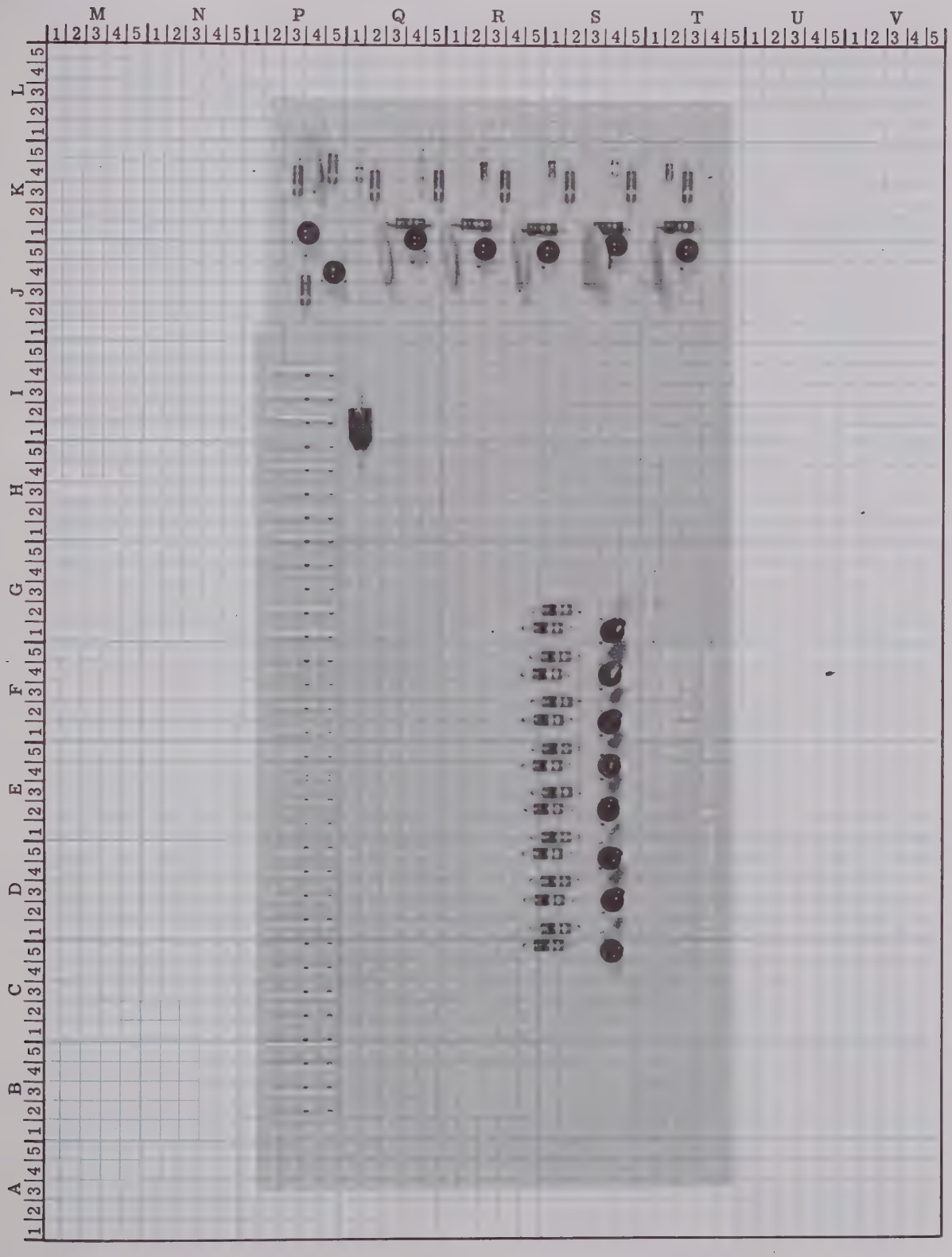


Figure 10. REMOTE RANGE & PRINT LOGIC P/C ASSEMBLY - 8421 CODE OPTION

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q1	E2-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	8	2	
Q2	D5-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q3	D3-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q4	C5-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q5	G1-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q6	F4-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q7	F2-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q8	E4-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q9	J5-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	7	2	
Q10	J5-S4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q11	J5-S1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q12	J5-R3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q13	K1-Q4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q14	J4-P5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q15	K1-P4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
R1	E2-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	16		
R2	E3-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R3	D5-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R4	E1-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R5	D3-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R6	D3-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R7	C5-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R8	D1-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R9	G1-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R10	G2-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R11	F4-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R12	F5-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R13	F2-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R14	F3-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R15	E4-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R16	E5-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R17	K4-Q2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	9		
R18	K1-T2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	5		
R19	K3-T3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R20	K1-S4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R21	K3-S5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R22	K1-R5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R23	K3-S2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R24	K2-R2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R25	K3-R3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R26	K2-Q4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R27	K4-Q5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R28	J3-P3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R29	K4-P5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R30	K4-P3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
A4		PRINT LOGIC P/C ASSEMBLY - 8421 CODE OPTION - Figure 11	1702-228452 (9500A-4022)	89536	1702-228452	REF		
P1	H2-P4	Connector, 32 contact	2816-234930	91662	02-032-013-5-200	1		
Q1	G1-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	21	4	
Q2	G3-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q3	F1-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q4	F1-T1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q5	F4-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q6	E4-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q7	D5-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q8	E1-T1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q9	D2-S5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q10	C5-S5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q11	I2-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q12	H5-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		

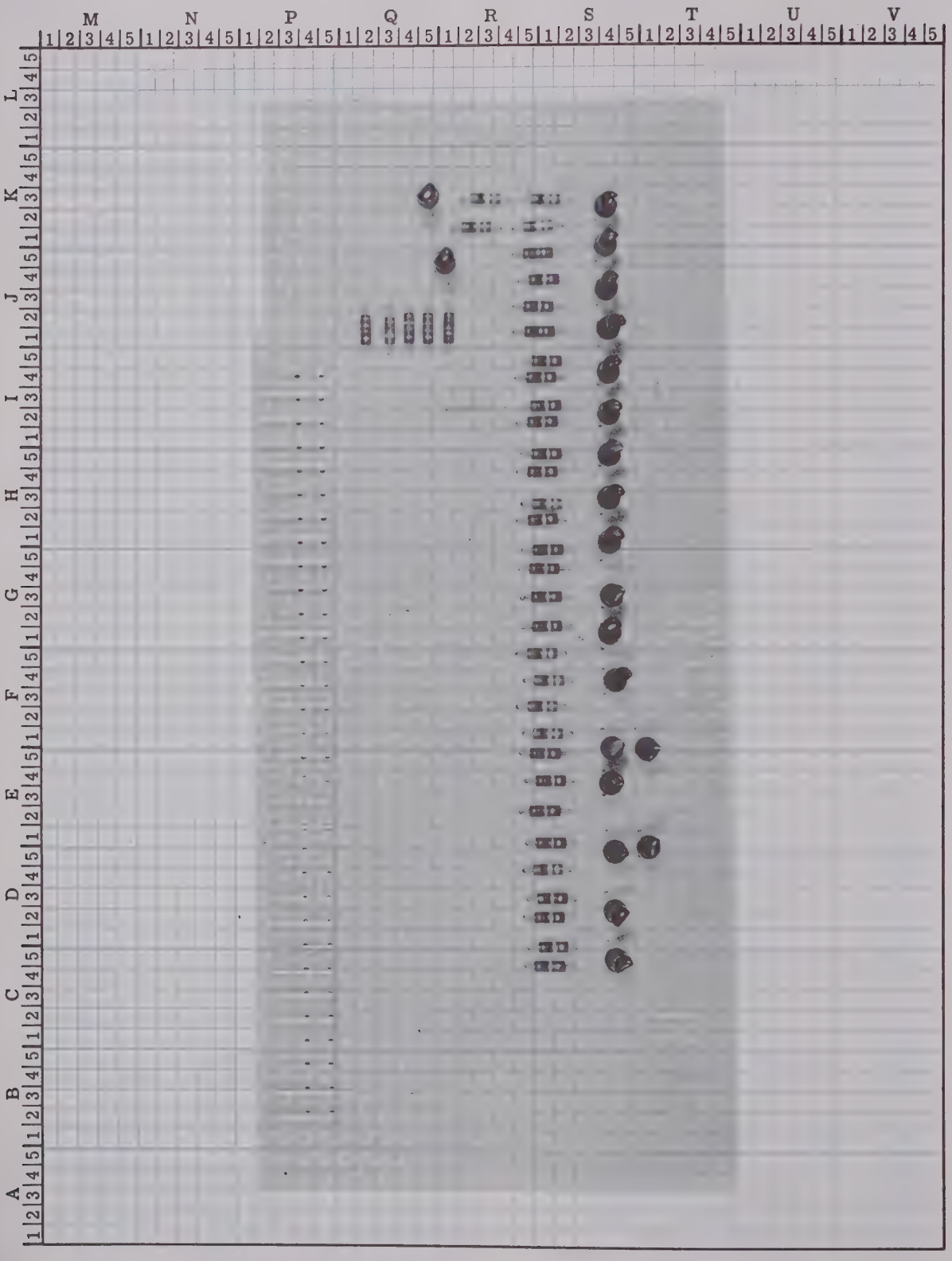


Figure 11. PRINT LOGIC P/C ASSEMBLY - 8421 CODE OPTION

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q13	H3-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q14	H1-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q15	K3-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q16	K3-Q5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q17	K1-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q18	J4-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q19	J2-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q20	I4-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q21	J5-R1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
R1	F5-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	31		
R2	G2-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R3	G3-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R4	F1-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R5	E5-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R6	F4-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R7	F3-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R8	E4-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R9	E2-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R10	E1-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R11	D4-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R12	D3-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R13	D2-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R14	D1-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R15	C5-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R16	I3-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R17	I2-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R18	H5-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R19	H4-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R20	H3-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R21	H2-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R22	G5-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R23	G4-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R24	K3-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R25	K2-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R26	K2-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R27	K3-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R28	J5-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	3		
R29	J4-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R30	J3-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R31	J1-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R32	I5-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R33	I4-S1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R34	J2-R1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R35	J2-Q5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	2		
R36	J2-Q4	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	1		
R37	J2-Q3	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	1		
R38	J2-Q2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
		RMS DIGITAL VOLTMETER - 4221 Code Option NOTE: The basic Model 9500A can be modified in the field by installing the 4221 Print Option Kit, part number 3158-239772. The kit includes P1 and the A3 and A4 P/C assemblies. Instructions for installing the option kit are given in the preceding text.	9500A-04					
A3		Remote Range and Print Logic P/C Assembly - 4221 Code Option (See Figure 12)	1702-226548 (9500A-4003)	89536	1702-226548	1		
A4		Print Logic P/C Assembly - 4221 Code Option (See Figure 13)	1702-226555 (9500A-4004)	89536	1702-226555	1		
P1		Connector, male, 37 contact	2105-235093	71785	DC37P	1		
A3		REMOTE RANGE AND PRINT LOGIC P/C ASSEMBLY - 4221 CODE OPTION - Figure 12	1702-226548 (9500A-4003)	89536	1702-226548	REF		
C1	I5-T3	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	6		
C2	I5-S5	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C3	I5-S2	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C4	I5-R4	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C5	I5-R1	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
C6	J5-Q1	Cap, cer, 0.01 uf +80/-20%, 500v	1501-105668	56289	29C9B5	REF		
CR1	C3-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	12	3	
CR2	C2-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR3	D3-R2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR4	F3-T3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR5	F4-T3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR6	G1-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR7	J4-R1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR8	J4-T3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR9	J4-T1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR10	J4-S3	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		

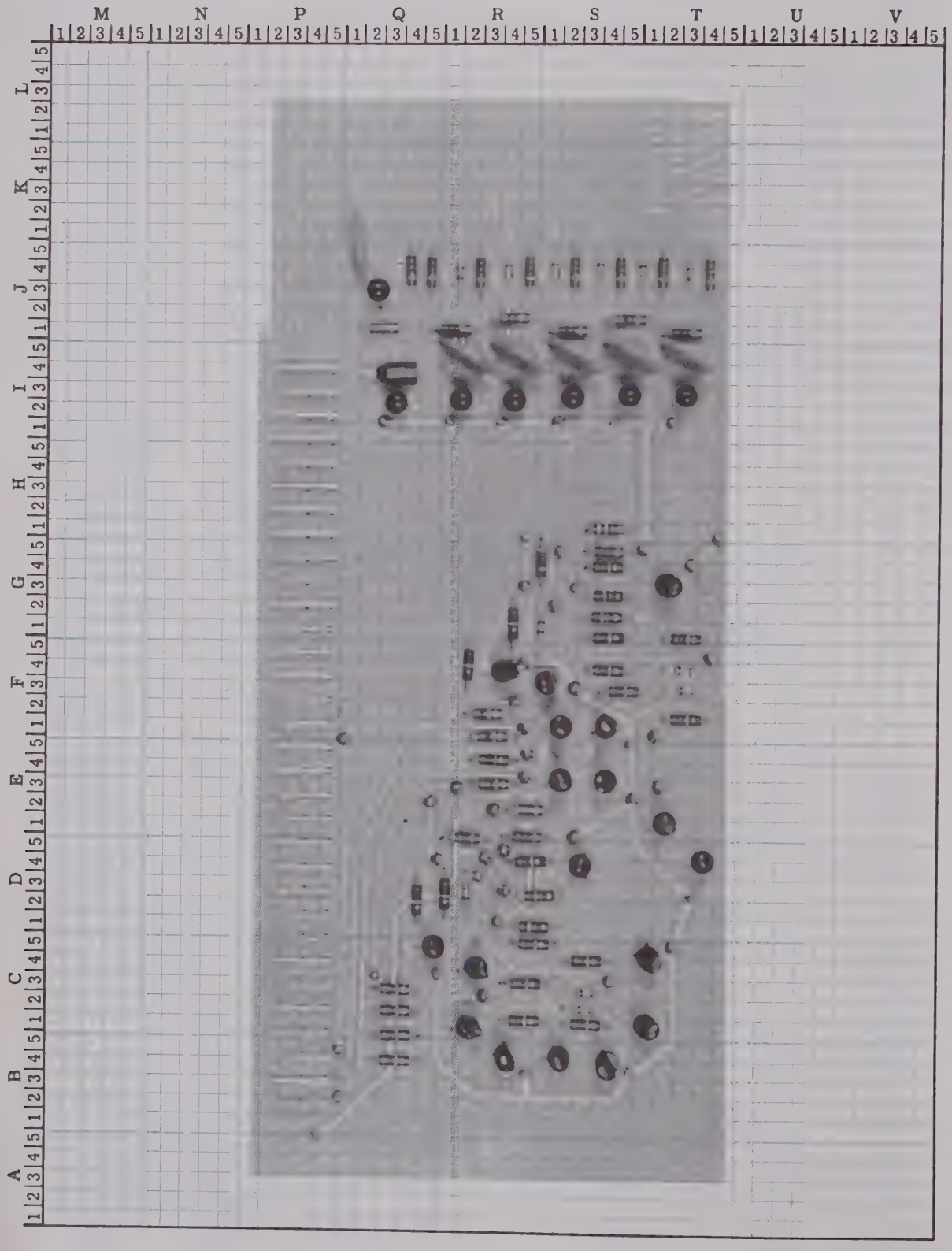


Figure 12. REMOTE RANGE & PRINT LOGIC P/C ASSEMBLY - 4221 CODE OPTION

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
CR11	J4-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR12	J4-R4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR13	I4-Q3	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	1	1	
P1	H2-P4	Connector, 32 contact	2816-234930	91662	02-032-013-5-200	1		
Q1	B4-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	18	4	
Q2	B4-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q3	C1-R2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q4	B4-R4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q5	D4-S3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q6	C1-T1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q7	C5-T1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q8	C4-R3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q9	C5-Q5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q10	E3-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q11	E3-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q12	F1-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q13	F1-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q14	E1-T2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q15	G3-T2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q16	D4-T4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q17	F3-S1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q18	F4-R4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q19	I3-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	7	2	
Q20	I3-S5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q21	I3-S2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q22	I3-R4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q23	I3-R1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q24	I3-Q3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q25	J3-Q2	Tstr, silicon, NPN	4805-159885	07910	CS23030	REF		
R1	B4-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	8		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R2	C5-R5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	16		
R3	D1-R5	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	4		
R4	D3-S1	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R5	B5-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R6	C3-R5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R7	C1-R5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R8	E2-R5	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	4		
R9	E1-R5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	11		
R10	D4-R5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R11	C4-S3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R12	C1-S3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R13	D3-R1	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R14	C2-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R15	D5-R2	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R16	C3-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R17	D2-Q4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R18	E3-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R19	G1-S4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R20	G2-S4	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R21	G3-S4	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R22	E4-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R23	F4-S4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R24	F2-T3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R25	F3-S5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R26	G5-S4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R27	H1-S4	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R28	G1-T3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R29	G1-R4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R30	F1-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R31	G4-S1	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R32	F2-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
CR11	J4-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR12	J4-R4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR13	I4-Q3	Diode, silicon, 1 amp, 600 piv	4802-112383	05277	1N4822	1	1	
P1	H2-P4	Connector, 32 contact	2816-234930	91662	02-032-013-5-200	1		
Q1	B4-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	18	4	
Q2	B4-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q3	C1-R2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q4	B4-R4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q5	D4-S3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q6	C1-T1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q7	C5-T1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q8	C4-R3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q9	C5-Q5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q10	E3-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q11	E3-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q12	F1-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q13	F1-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q14	E1-T2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q15	G3-T2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q16	D4-T4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q17	F3-S1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q18	F4-R4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q19	I3-T3	Tstr, silicon, NPN	4805-159855	07910	CS23030	7	2	
Q20	I3-S5	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q21	I3-S2	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q22	I3-R4	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q23	I3-R1	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q24	I3-Q3	Tstr, silicon, NPN	4805-159855	07910	CS23030	REF		
Q25	J3-Q2	Tstr, silicon, NPN	4805-159885	07910	CS23030	REF		
R1	B4-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	8		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R2	C5-R5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	16		
R3	D1-R5	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	4		
R4	D3-S1	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R5	B5-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R6	C3-R5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R7	C1-R5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R8	E2-R5	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	4		
R9	E1-R5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	11		
R10	D4-R5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R11	C4-S3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R12	C1-S3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R13	D3-R1	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R14	C2-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R15	D5-R2	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R16	C3-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R17	D2-Q4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R18	E3-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R19	G1-S4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R20	G2-S4	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R21	G3-S4	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R22	E4-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R23	F4-S4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R24	F2-T3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R25	F3-S5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R26	G5-S4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R27	H1-S4	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R28	G1-T3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R29	G1-R4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R30	F1-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R31	G4-S1	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R32	F2-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R33	F4-R2	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R34	J4-R2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R35	J1-T3	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	5		
R36	J4-T4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R37	J2-S5	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R38	J4-T2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R39	J1-S2	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R40	J4-S5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R41	J2-R4	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R42	J4-S2	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R43	J1-R1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R44	J4-R5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R45	J4-Q5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R46	J1-Q3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R47	J4-Q4	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R48	G4-S4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
A4		PRINT LOGIC P/C ASSEMBLY - 4221 CODE OPTION - Figure 13	1702-226555 (9500A-4004)	89536	1702-226555	REF		
CR2	D2-S5	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	6	2	
CR3	D2-T1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR5	B4-T4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR6	G1-R4	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR7	G1-S1	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
CR8	E5-T2	Diode, silicon, 150 ma	4802-203323	03508	DHD1105	REF		
P1	H2-P4	Connector, 32 contact	2816-234930	91662	02-032-013-5-200	1		
Q1	C4-S3	Tstr, silicon, NPN	4805-168708	03508	2N3391	30	5	
Q2	C3-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q3	C4-R3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q4	C3-R5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		

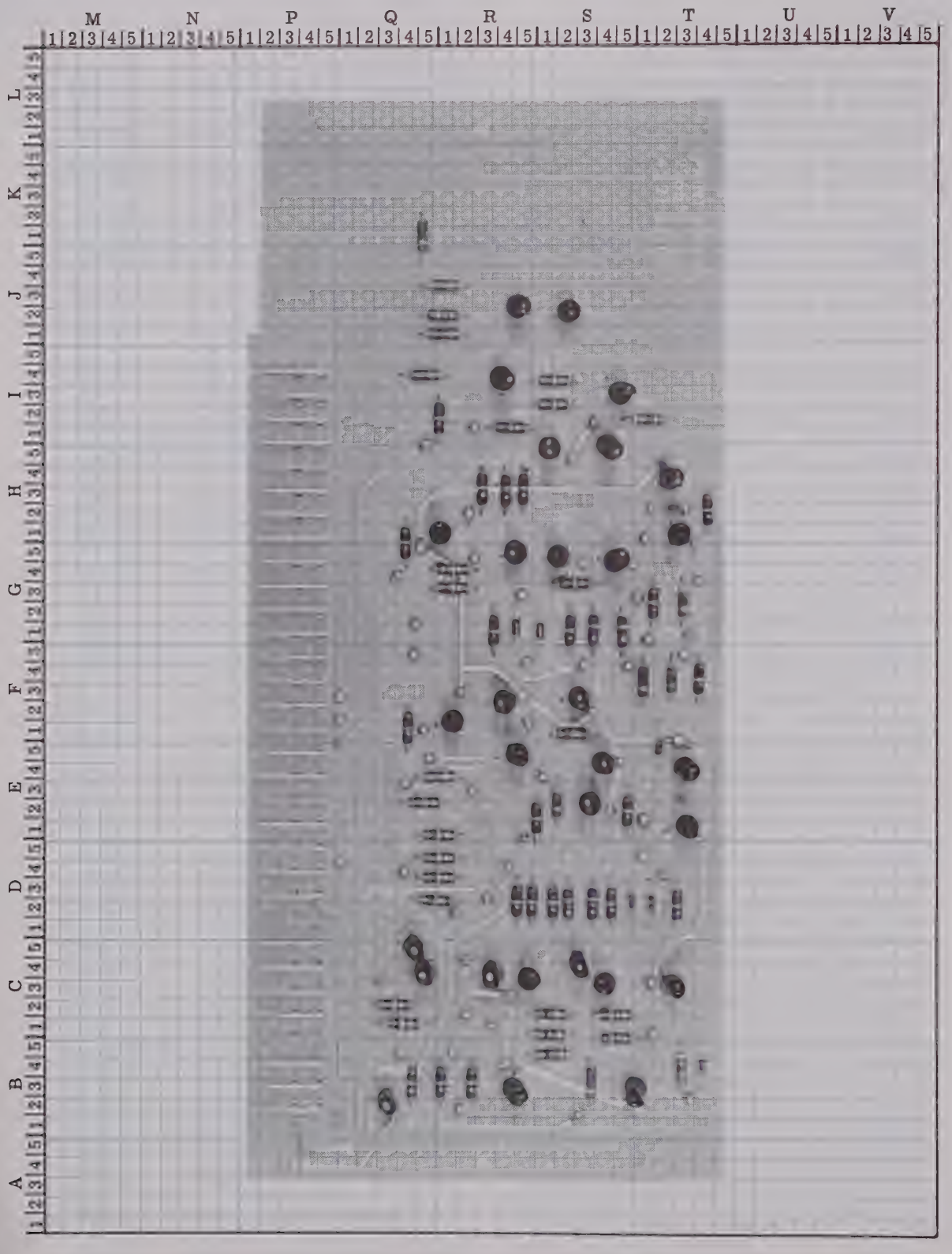


Figure 13. PRINT LOGIC P/C ASSEMBLY - 4221 CODE OPTION

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
Q5	E2-S3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q6	E1-T3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q7	E4-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q8	C3-T2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q9	F1-R1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q10	B3-R4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q11	B3-S5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q12	B2-Q3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q13	G5-R4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q14	G5-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q15	E5-R5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q16	F3-S3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q17	H1-T3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q18	H4-T2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q19	G5-S5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q20	E4-T3	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q21	F2-R4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q22	H5-S1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q23	I4-R4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q24	J2-S2	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q25	H1-R1	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q26	I3-S5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q27	H5-S4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q28	J2-R5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q29	C5-Q4	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
Q30	C4-Q5	Tstr, silicon, NPN	4805-168708	03508	2N3391	REF		
R1	C2-Q3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	14		
R2	D2-S1	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	21		
R3	D2-S2	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	7		
R4	D2-S3	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R5	C1-Q4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R6	D2-R5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R7	D2-R5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R8	E4-R1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	5		
R9	E2-S2	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	6		
R10	D2-Q5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R11	E1-S1	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R12	D2-S4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R13	T2-T3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R14	E2-S5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R15	D4-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R16	B4-T3	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R17	E2-Q5	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R18	B3-R2	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R19	B3-S3	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R20	B3-Q4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R21	B5-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	4		
R22	B3-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R23	C2-S5	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R24	C1-S5	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R25	G3-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R26	G1-R3	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R27	G1-S5	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R28	G1-S3	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R29	D5-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R30	F1-S2	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R31	H2-T4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R32	G1-S2	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R33	F4-T1	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R34	F4-T2	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R35	G3-S2	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R36	F4-T4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		

REF DESIG	INDEX NO	DESCRIPTION	STOCK NO	MFR	MFR PART NO	TOT QTY	REC QTY	USE CODE
R37	G4-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R38	G3-T1	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R39	G3-T3	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R40	E1-R1	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R41	F1-Q4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R42	H3-R5	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R43	I1-R4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R44	H3-R4	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R45	I2-R1	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R46	I4-S1	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R47	H3-R3	Res, comp, 10k ±5%, 1/4w	4704-148106	01121	CB1035	REF		
R48	H1-Q4	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R49	I3-S1	Res, comp, 15k ±5%, 1/4w	4704-148114	01121	CB1535	REF		
R50	J1-R1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R51	J2-R1	Res, comp, 6.8k ±5%, 1/4w	4704-148098	01121	CB6825	REF		
R52	I4-Q5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R53	J4-R1	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R54	K1-Q5	Res, comp, 2.2k ±5%, 1/4w	4704-148049	01121	CB2225	REF		
R55	I2-T1	Res, comp, 4.7k ±5%, 1/4w	4704-148072	01121	CB4725	REF		
R56	C2-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		
R57	C1-S1	Res, comp, 1k ±5%, 1/4w	4704-148023	01121	CB1025	REF		

APPENDIX A

FEDERAL SUPPLY CODE FOR MANUFACTURERS

A-1. CODE TO NAME

A-2. The following five-digit code numbers are listed in numerical sequence along with the manufacturer's name and address to which the code has been assigned. The Federal Supply Code has been taken from Cataloging Handbook H 4-2, Code to Name.

00213	Sage Electronics Corp. Rochester, New York
00327	Welwyn International, Inc. Westlake, Ohio
00656	Aerovox Corp New Bedford, Massachusetts
00779	AMP Inc. Harrisberg, Pennsylvania
01121	Allen-Bradley Co. Milwaukee, Wisconsin
01281	TRW Semiconductors Lawndale, California
01295	Texas Instruments, Inc. Semiconductor Components Div. Dallas, Texas
01686	RCL Electronics Inc. Manchester, New Hampshire
01730	Deleted
01884	Dearborn Electronics Inc. Orlando, Florida
02114	Ferroxcube Corp Saugerties, New York
02606	Replaced by 15801
02660	Amphenol-Borg Elect. Corp. Broadview, Illinois
02799	Arco Capacitors, Inc. Los Angeles, California
03614	Replaced by 71400
03651	Replaced by 44655
03797	Eldema Corp. Compton, California
03877	Transitron Electronic Corp. Wakefield, Massachusetts
03888	Pyrofilm Resistor Co., Inc. Cedar Knolls, New Jersey
03911	Clairex Corp. New York, New York
03980	Murrhead Instruments, Inc. Mountainside, New Jersey
04009	Arrow Hart and Hegemen Electronic Company Hartford, Connecticut
04062	Replaced by 72136
04202	Replaced by 81312
04217	Essex Wire Corp Wire & Cable Div. Anaheim, California
04221	Aemco Div. of Midtex Inc. Mankato, Minnesota
04645	Replaced by 75376
04713	Motorola Semiconductor Products Inc. Phoenix, Arizona
05082	Replaced by 94154
05236	Jonathan Mfg. Co. Fullerton, California
05277	Westinghouse Electric Corp. Semiconductor Dept. Youngwood, Pennsylvania
05278	Replaced by 43543
05397	Union Carbide Corp. Electronics Div. Cleveland, Ohio
05571	Sprague Electric Co Pacific Div. Los Angeles, California
05704	Alac, Inc. Glendale, California
05820	Wakefield Engineering Ind. Wakefield, Massachusetts
06001	General Electric Company Capacitor Department Irmo, South Carolina
06136	Replaced by 63743
06473	Amphenol Space & Missile Sys. Chatsworth, California
06555	Beede Electrical Instrument Co. Penacook, New Hampshire
06739	Electron Corp. Littletown, Colorado
06743	Clevite Corp. Cleveland, Ohio
06751	Semcor Div. Components Phoenix, Arizona
06860	Gould National Batteries Inc. City of Industry, California
06980	Eitel-McCullough, Inc. San Carlos, California
07115	Replaced by 14674
07138	Westinghouse Electric Corp Electronic Tube Div. Elmira, New York
07263	Fairchild Semiconductor Div. of Fairchild Camera & Instrument Corp. Mountain View, California
07344	Bircher Co., Inc. Rochester, New York
07792	Lerma Engineering Corp Northampton, Massachusetts
07910	Continental Device Corp. Hawthorne, California
08530	Reliance Mica Corp. Brooklyn, New York
08792	CBS Electronics Semiconductor Operations-Div. of CBS Inc. Lowell, Massachusetts
08806	General Electric Co. Miniature Lamp Dept. Cleveland, Ohio
08863	Nylomatic Corp. Norrisville, Pennsylvania
08988	Skottie Electronics Inc. Archbald, Pennsylvania
09922	Burndy Corp. Norwalk, Connecticut
11237	Chicago Telephone of Calif. Inc. South Pasadena, California
11358	CBS Electronics Div. of CBS Inc. Newburyport, Massachusetts
11403	Best Products Co. Chicago, Illinois
11503	Keystone Mfg Div. of Avis Industrial Corp. Warren, Michigan
12014	Chicago Rivet & Machine Co. Bellwood, Illinois
12040	National Semiconductor Corp. Danburry, Connecticut
12060	Diodes, Inc. Chatsworth, California
12136	Philadelphia Handle Co. Camden, New Jersey
12323	Presin Co., Inc. Shelton, Connecticut
12327	Freeway Washer & Stamping Co. Cleveland, Ohio
12400	Replaced by 75042
12617	Hamlin Inc. Lake Mills, Wisconsin
12697	Clarostat Mfg. Co. Dover, New Hampshire
12749	James Electronics Chicago, Illinois

12856	Micrometals Sierra Madre, California
12954	Dickson Electronics Corp. Scottsdale, Arizona
13606	Sprague Electric Co. Transistor Div. Concord, New Hampshire
13839	Replaced by 23732
14099	Semtech Corp. Newbury Park, California
14193	California Resistor Corp. Santa Monica, California
14298	American Components, Inc. Conshohocken, Pennsylvania
14655	Cornell-Dubilier Electronics Newark, New Jersey
14674	Corning Glass Works Corning, New York
14752	Electro Cube Inc. San Gabriel, California
14869	Replaced by 96853
15636	Elec-Trol Inc. Northridge, California
15801	Fenwal Electronics Inc. Framingham, Massachusetts
15818	Amelco Semiconductor Div. of Teledyne Inc. Mountain View, California
15849	Useco, Inc. Mt. Vernon, New York
15909	Replaced by 17870
16332	Replaced by 28478
16473	Cambridge Scientific Ind. Inc. Cambridge, Maryland
16742	Paramount Plastics Downey, California
16758	Delco Radio Div. of General Motors Kokomo, Indiana
17069	Circuit Structures Lab. Upland, California
17856	Siliconix, Inc. Sunnyvale, California
17870	Dave=Div. of Thomas A. Edison Ind.--McGraw-Edison Co. Manchester, New Hampshire
18083	Deleted
18178	Vactec Inc. Maryland Heights, Missouri
18736	Voltronics Corp. Hanover, New Jersey
19429	Montronics, Inc. Seattle, Washington
19451	Perine Machinery & Supply Co. Seattle, Washington
19701	Electra Mfg. Co. Independence, Kansas
20584	Enochs Mfg. Co. Indianapolis, Indiana
22767	ITT Semiconductors Div. of ITT Palo Alto, California
23732	Tracor Rockville, Maryland
24248	Southco Div. of South Chester Corp. Lester, Pennsylvania
24655	General Radio Co. West Concord, Massachusetts
25403	Amperex Electronic Corp Semiconductor & Receiving Tube Division Slatersville, Rhode Island
28478	Deltrol Controls Corp. Milwaukee, Wisconsin
28520	Heyman Mfg. Co. Kenilworth, New Jersey
30323	Illinois Tool Works Inc. Chicago, Illinois
33173	General Electric Co. Tube Dept. Owensboro, Kentucky
37942	Mallory, P. R., & Co., Inc. Indianapolis, Indiana
38315	Honeywell Inc. Precision Meter Div. Manchester, New Hampshire
42498	National Company Melrose, Massachusetts
43543	Nytronics Inc. Transformer Co. Div. Alpha, New Jersey
44655	Ohmite Mfg. Co. Skokie, Illinois
49671	Radio Corp. of America New York, New York
49956	Raytheon Company Lexington, Maine
53021	Sangamo Electric Co. Springfield, Illinois
55026	Simpson Electric Company Chicago, Illinois
56289	Sprague Electric Co. North Adams, Massachusetts
58474	Superior Electric Co. Bristol, Connecticut
60399	Torrington Mfg. Co. Torrington, Connecticut
62460	Deleted
63743	Ward Leonard Electric Co. Mount Vernon, New York
64834	West Mfg. Co. San Francisco, California
65092	Weston Instruments Inc. Newark, New Jersey
66150	Winslow Tele-Tronics Inc. Asbury Park, New Jersey
70563	Amperite Company Union City, New Jersey
70903	Belden Mfg. Co. Chicago, Illinois
71002	Birnbach Radio Co., Inc. New York, New York
71400	Bussmann Mfg. Div. of McGraw-Edison Co. St. Louis, Missouri
71450	CTS Corp. Elkhart, Indiana
71468	ITT Cannon Electric Inc. Los Angeles, California
71482	Clare, C P. & Co. Chicago, Illinois
71590	Centralab Div. of Globe Union Inc. Milwaukee, Wisconsin
71707	Coto Coil Co., Inc. Providence, Rhode Island
71744	Chicago Miniature Lamp Works Chicago, Illinois
71785	Cinch Mfg. Co. & Howard B. Jones Div. Chicago, Illinois
72005	Driver, Wilber B., Co. Newark, New Jersey
72092	Replaced by 06980
72136	Electro Motive Mfg. Co. Willimantic, Connecticut
72259	Nytronics Inc. Berkeley Heights, New Jersey
72354	Deleted
72619	Dialight Corp Brooklyn, New York
72653	G. C. Electronics Rockford, Illinois
72665	Replaced by 90303
72794	Dzus Fastener Co., Inc. West Islip, New York
72928	Gudeman Co. Chicago, Illinois
72982	Erie Tech. Products Inc. Erie, Pennsylvania
73138	Beckman Instruments Inc. Helipot Division Fullerton, California
73293	Hughes Aircraft Co. Electron Dynamics Div. Newport Beach, California
73445	Amperex Electronic Corp. Hicksville, New York
73559	Carling Electric Inc. Hartford, Connecticut
73586	Circle F Industries Trenton, New Jersey
73734	Federal Screw Products, Inc. Chicago, Illinois
73743	Fischer Special Mfg. Co. Cincinnati, Ohio
73899	JFD Electronics Co. Brooklyn, New York
73949	Guardian Electric Mfg. Co. Chicago, Illinois
74199	Quam Nichols Co. Chicago, Illinois
74217	Radio Switch Corp. Marlboro, New Jersey
74276	Signalite Inc. Neptune, New Jersey
74306	Piezo Crystal Co. Carlisle, Pennsylvania
74542	Hoyt Elect. Instr. Works Penacook, New Hampshire
74970	Johnson, E. F., Co. Waseca, Minnesota
75042	IRC Inc. Philadelphia, Pennsylvania
75376	Kurz-Kasch, Inc. Dayton, Ohio
75382	Kulka Electric Corp. Mt. Vernon, New York
75915	Littlefuse Inc. Des Plaines, Illinois
76854	Oak Mfg. Co. Crystal Lake, Illinois
77342	Potter & Brumfield Div. of Amer. Machine & Foundry Princeton, Indiana
77969	Rubbercraft Corp. of Calif. LTD. Torrance, California

78189 Shakeproof
Div. of Illinois Tool Works
Elgin, Illinois

78277 Sigma Instruments, Inc.
South Braintree, Massachusetts

78488 Stackpole Carbon Co.
St. Marys, Pennsylvania

78553 Tinnerman Products
Cleveland, Ohio

79136 Waldes Kohinoor Inc.
Long Island City, New York

79497 Western Rubber Company
Goshen, Indiana

79963 Zierick Mfg. Corp.
New Rochelle, New York

80031 Mepco
Div. of Sessions Clock Co.
Morristown, New Jersey

80145 API Instruments Co.
Chesterland, Ohio

80183 Sprague Products
North Adams, Massachusetts

80294 Bourns Inc.
Riverside, California

80583 Hammarlund Co., Inc.
Mars Hill, North Carolina

80640 Stevens, Arnold Inc.
Boston, Massachusetts

81073 Grayhill Inc.
La Grange, Illinois

81312 Winchester Electronics
Div. of Litton Industries
Oakville, Connecticut

81439 Therm-O-Disc Inc.
Mansfield, Ohio

81483 International Rectifier Corp.
El Segundo, California

81590 Korry Mfg. Co.
Seattle, Washington

82376 Deleted

82389 Switchcraft Inc.
Chicago, Illinois

82415 Price Electric Corp.
Frederick, Maryland

82872 Roanwell Corp.
New York, New York

82877 Rotron Mfg. Co., Inc.
Woodstock, New York

82879 ITT Wire & Cable Div.
Pawtucket, Rhode Island

83003 Varo Inc.
Garland, Texas

83298 Bendix Corp.
Electric Power Division
Eatontown, New Jersey

83330 Smith, Herman H., Inc.
Brooklyn, New York

83478 Rubbercraft Corp. of America
New Haven, Connecticut

83594 Burroughs Corp.
Electronic Components Div.
Plainfield, New Jersey

83740 Union Carbide Corp.
Consumer Products Div.
New York, New York

84171 Arco Electronics, Inc.
Great Neck, New York

84411 TRW
Ogallala, Nebraska

86577 Precision Metal Products
Stoneham, Massachusetts

86684 Radio Corp. of America
Electronic Components & Devices
Harrison, New Jersey

86689 Deleted

87034 Marco-Oak Inc.
Anaheim, California

88419 Use 14655

88690 Replaced by 04217

89536 Fluke, John Mfg. Co., Inc.
Seattle, Washington

89730 Replaced by 08806

90201 Mallory Capacitor Co.
Indianapolis, Indiana

90215 Best Stamp & Mfg. Co.
Kansas City, Missouri

90211 Square D Co.
Chicago, Illinois

90303 Mallory Battery Co.
Tarrytown, New York

91293 Johanson Mfg. Co.
Boonton, New Jersey

91407 Replaced by 58474

91637 Dale Electronics Inc.
Columbus, Nebraska

91662 Elco Corp.
Willow Grove, Pennsylvania

91737 Gremar Mfg. Co., Inc.
Wakefield, Massachusetts

91802 Industrial Devices, Inc.
Edgewater, New Jersey

91836 King's Electronics
Tuckahoe, New York

91929 Honeywell Inc.
Micro Switch Div.
Freeport, Illinois

91934 Miller Electric Co., Inc.
Pawtucket, Rhode Island

93332 Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145 Replaced by 49956

94154 Tung-Sol
Div. of Wagner Electric Corp.
Newark, New Jersey

95146 Alco Electronics Products Inc.
Lawrence, Massachusetts

95263 Leecraft Mfg. Co.
Long Island City, New York

95264 Replaced by 98278

95275 Vitramon Inc.
Bridgeport, Connecticut

95303 Radio Corp. of America
Solid State & Receiving Tube Div.
Cincinnati, Ohio

95354 Methode Mfg. Corp.
Rolling Meadows, Illinois

95712 Dage Electric Co., Inc.
Franklin, Indiana

95987 Weckesser Co., Inc.
Chicago, Illinois

96733 San Fernando Electric Mfg. Co.
San Fernando, California

96853 Rustrak Instrument Co.
Manchester, New Hampshire

96881 Thomson Industries, Inc.
Manhasset, New York

97540 Master Mobile Mounts
Div. of Whitehall Electronics Corp.
Los Angeles, California

97913 Industrial Electronic Hdware Corp.
New York, New York

97945 White, S. S. Co.
Plastics Div.
New York, New York

97966 Replaced by 11358

98094 Replaced by 49956

98278 Microdot Inc.
Pasadena, California

98291 Sealectro Corp.
Conhex Div
Mamaroneck, New York

98388 Accurate Rubber & Plastics
Culver City, California

98743 Replaced by 12749

98925 Deleted

99120 Plastic Capacitors, Inc.
Chicago, Illinois

99217 Southern Electronics Corp.
Burbank, California

99515 Marshall Industries
Capacitor Div.
Monrovia, California

Revised August 1, 1968
Using H4-1 and H4-2
Dated June , 1968

WARRANTY

The JOHN FLUKE MFG. CO., INC. warrants each instrument manufactured by them to be free from defects in material and workmanship. Their obligation under this Warranty is limited to servicing or adjusting an instrument returned to the factory for that purpose, and to making good at the factory any part or parts thereof; except tubes, fuses, choppers and batteries, which shall, within one year after making delivery to the original purchaser, be returned by the original purchaser with transportation charges prepaid, and which upon their examination shall disclose to their satisfaction to have been thus defective. If the fault has been caused by misuse or abnormal conditions of operation, repairs will be billed at a nominal cost. In this case, an estimate will be submitted before work is started, if requested.

If any fault develops, the following steps should be taken.

1. Notify the John Fluke Mfg. Co., Inc., giving full details of the difficulty, and include the Model number, type number, and serial number. On receipt of this information, service data or shipping instructions will be forwarded to you.

2. On receipt of the shipping instructions, forward the instrument prepaid, and repairs will be made at the factory. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the Warranty.

SHIPPING

All shipments of John Fluke Mfg. Co., Inc. instruments should be made via Railway Express prepaid. The instrument should be shipped in the original packing carton; or if it is not available, use any suitable container that is rigid. If a substitute container is used, the instrument should be wrapped in paper and surrounded with at least four inches of excelsior or similar shock-absorbing material.

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be thoroughly inspected immediately upon receipt. All material in the container should be checked against the enclosed packing list. The manufacturer will not be responsible for shortages against the packing sheet unless notified immediately. If the instrument fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to John Fluke Mfg. Co., Inc. Upon receipt of this report you will be advised of the disposition of the equipment for repair or replacement. Include the model number, type number, and serial number when referring to this instrument for any reason.

The John Fluke Mfg. Co., Inc. will be happy to answer all application questions which will enhance your use of this instrument. Please address your requests to:

JOHN FLUKE MFG. CO., INC., P. O. BOX 7428, SEATTLE 33, WASHINGTON

SALES & SERVICE REPRESENTATIVES

ALABAMA

HUNTSVILLE
BCS Associates, Inc.
3322 South Memorial Parkway
Tel. (205) 881-6220
Zip 35801

ALASKA

SEATTLE
Instrument Specialists, Inc.
5950 Sixth Ave. South
Suite 106
Seattle, Washington 98108
Tel. (206) 767-4260

ARIZONA

PHOENIX
Barnhill Associates
4900 E. Indian School Road
Tel. (602) 959-2115
Zip 85251

CALIFORNIA

LOS ANGELES
Instrument Specialists, Inc.
1109 S. Central Ave.
Glendale, California 91204
Tel. (213) 245-9404

SAN FRANCISCO
Instrument Specialists, Inc.
2359 De La Cruz
Santa Clara, California 95050
Tel. (408) 244-1505

SAN DIEGO
Instrument Specialists Inc.
10459 A Roselle Street
San Diego, California 92121
Tel. (714) 453-1833

COLORADO

DENVER
Barnhill Associates
1170 S. Sheridan Blvd.
Tel. (303) 934-5505
Zip 80226

CONNECTICUT

HARTFORD
Instrument Representatives, Inc.
P.O. Box 165
Glastonbury, Connecticut 06033
Tel. (203) 633-0777

FLORIDA

ORLANDO
BCS Associates, Inc.
940 N. Fern Creek Ave.
Tel. (305) 843-1510
Zip 32803

HAWAII

HONOLULU
Industrial Electronics, Inc.
646 Queen Street
Tel. (808) 506-095
Zip 96813

ILLINOIS

CHICAGO
Cossens & Cudahy, Inc.
9501 W. Devon Ave.
Rosemont, Illinois 60018
Tel. (312) 825-1144

INDIANA

INDIANAPOLIS
Cozzens & Cudahy, Inc.
647 Mulford Court
Tel. (317) 244-2456
Zip 46234

MARYLAND

BALTIMORE
Electronic Marketing Assoc.
11501 Huff Court
Kensington, Maryland 20795
Tel. (301) 881-5300

MASSACHUSETTS

BOSTON
Instrument Representatives, Inc.
1046 Massachusetts Avenue
Arlington, Massachusetts 02174
Tel. (617) 646-1034

MICHIGAN

DETROIT
Technitron, Inc.
13657 Grand River Ave.
Tel. (313) 838-7324
Zip 48227

MINNESOTA

MINNEAPOLIS
Cozzens & Cudahy, Inc.
7710 Computer Ave.
Tel. (612) 920-1022
Zip 55435

MISSOURI

ST. LOUIS
Cozzens & Cudahy, Inc.
P.O. Box 10013
Lambert Field 63145
Tel. (314) 423-1234

NEW JERSEY

NEWARK
SBM Associates, Inc.
1519 Stuyvesant Avenue
Union, New Jersey 07083
Tel. (201) 687-8737

NEW MEXICO

ALBUQUERQUE
Barnhill Associates
827 Pennsylvania N.E.
Tel. (505) 265-7766
Zip 87110

NEW YORK

NEW YORK
SBM Associates, Inc.
28 Hobby Street
Pleasantville, New York 10570
Tel. (914) 769-1811

LONG ISLAND
SBM Associates, Inc.
528 Old Country Road
Plainview, Long Island 11803
Tel. (516) 433-1421

ROCHESTER
SBM Associates, Inc.
800 Linden Avenue
Tel. (716) 381-8330
Zip 14625

SYRACUSE
SBM Associates, Inc.
138 Pickard Bldg.
5858 E. Molloy Road
Tel. (315) 454-9377
Zip 13211

NORTH CAROLINA

GREENSBORO
BCS Associates, Inc.
1039 E. Wendover Avenue
Tel. (919) 273-1918
Zip 27405

OHIO

CLEVELAND
Technitron, Inc.
23203 Lorain Road
North Olmsted, Ohio 44070
Tel. (216) 734-0960

DAYTON
Technitron, Inc.
1250 W. Dorothy Lane
Tel. (513) 298-9964
Zip 45409

OREGON

SEATTLE
Instrument Specialists, Inc.
5950 Sixth Ave. South
Suite 106
Seattle, Washington 98108
Tel. (206) 767-4260

PENNSYLVANIA

PHILADELPHIA
Electronic Marketing Assoc.
210 Goddard Blvd. - Suite 100
King of Prussia, Pennsylvania
Tel. (215) 248-5050
Zip 19406

PITTSBURGH
Technitron, Inc.
114 Spring Grove Road
Tel. (412) 371-1231
Zip 15235

TEXAS

DALLAS
Barnhill Associates
Ste. 220
312 N. Central Express Way
Richardson, Texas
Tel. (214) 231-2573
Zip 75080

HOUSTON
Barnhill Associates
Suite 332
3810 Westheimer
Tel. (713) 621-0040
Zip 77027

WASHINGTON

SEATTLE
Instrument Specialists, Inc.
5950 Sixth Ave. South
Suite 106
Seattle, Washington 98108
Tel. (206) 767-4260

WASHINGTON, D.C.

Electronic Marketing Associates
11501 Huff Court
Kensington, Maryland 20795
Tel. (301) 881-5300

CANADA

BRITISH COLUMBIA

VANCOUVER
Allan Crawford Associates, Ltd.
721 Aldford Ave.
Annacis Industrial Estate
New Westminster
Tel. (604) 524-1161

ONTARIO

OTTAWA, 3
Allan Crawford Associates, Ltd.
376 Churchill Avenue — Suite 106
Tel. (613) 725-3354

TORONTO
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Kriegsstrasse 39
West Germany

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In Europe contact FLUKE NEDERLAND, N. V., Post Office Box 5053, Tilburg, The Netherlands

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Tel. (602) 264-9351

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TWX. 710-825-9645

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EG & G Standards and Calibration Laboratory
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TWX. 710-572-2193

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SBM Associates
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Tel. (716) 381-8330
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Tel. (216) 881-0300

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Honeywell Metrology Service
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Tucker Electronics Company
326 Kirby Street
Tel. (214) 272-3404

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Linear Standards Laboratory
8207 Millet
Tel. (713) 923-2796

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Stabro Laboratory
23 Kensington Ave.
Tel. (801) 467-8011

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TWX. 610-492-2119

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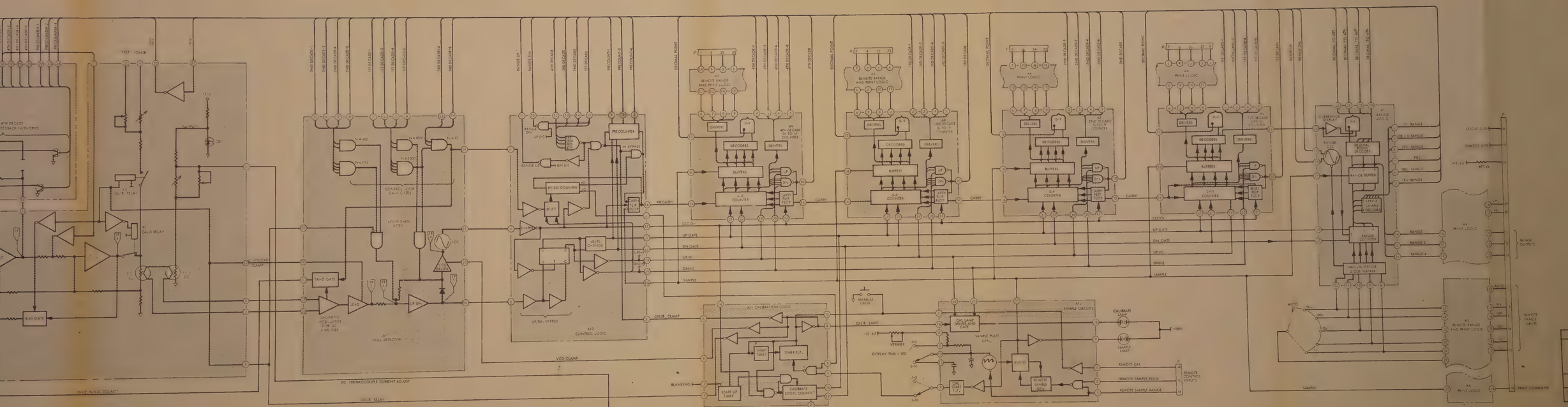
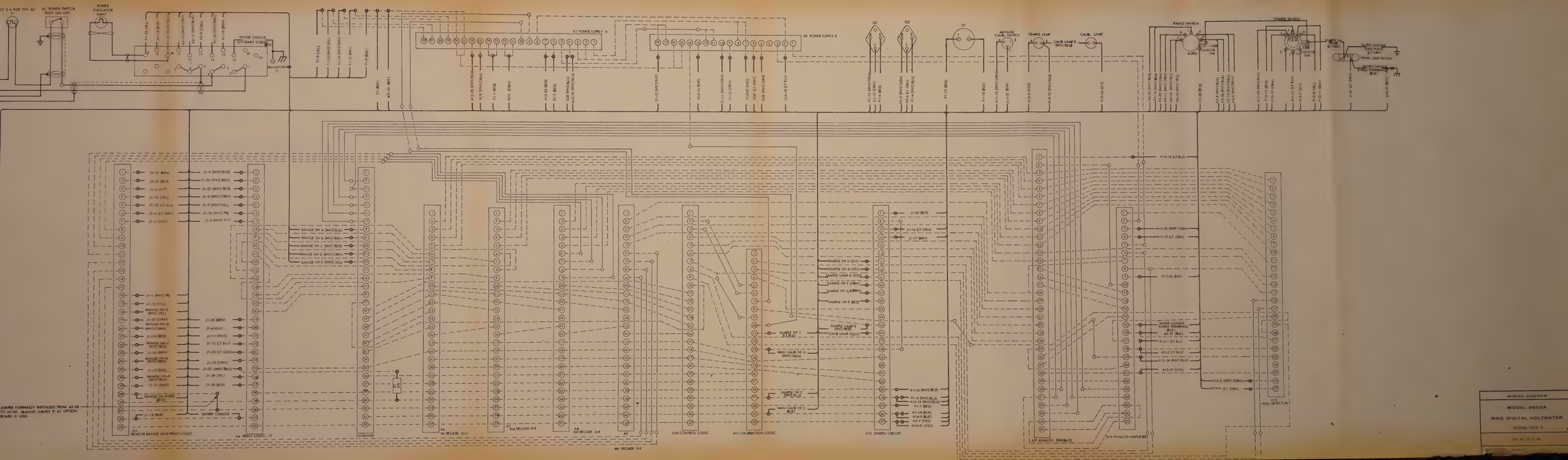
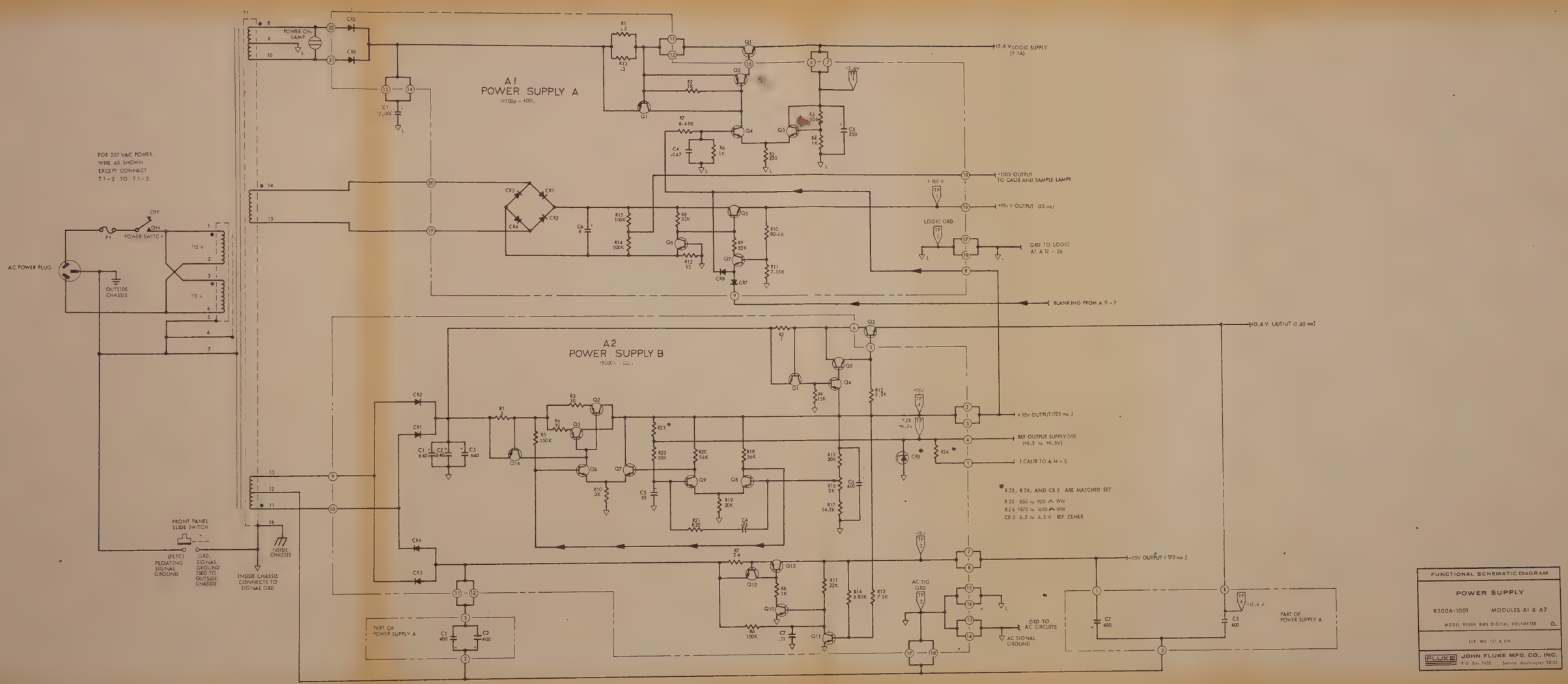
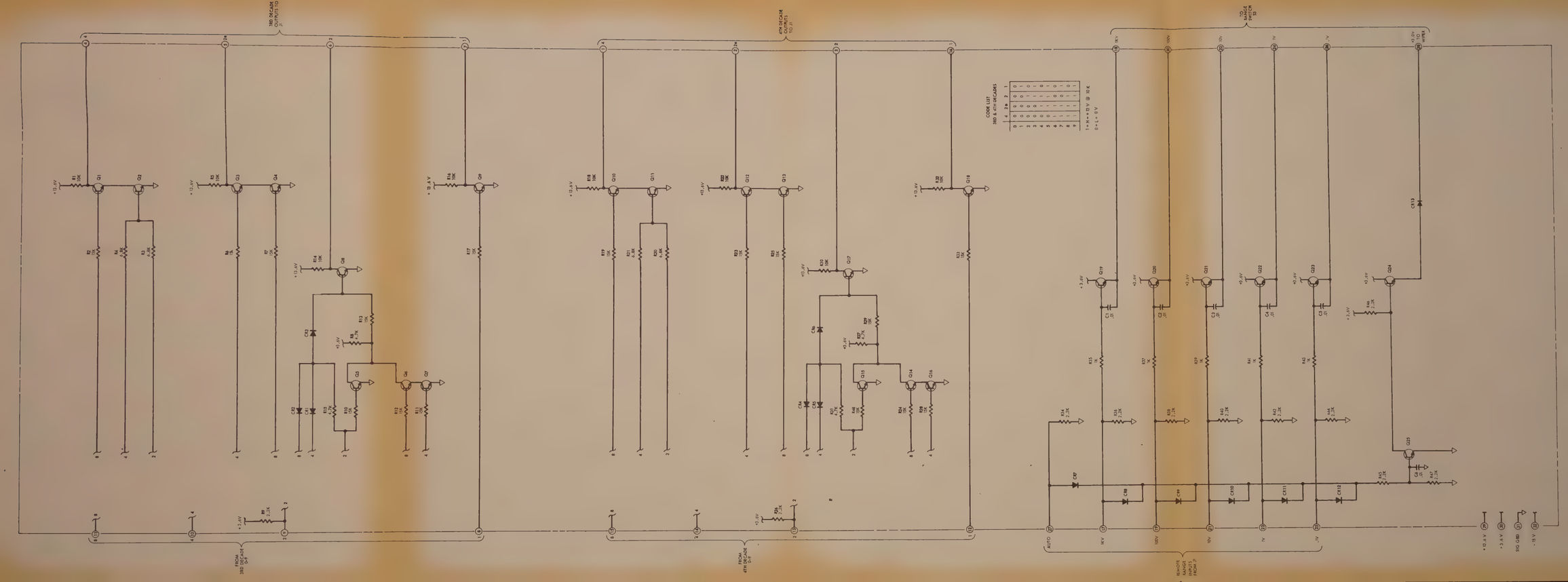
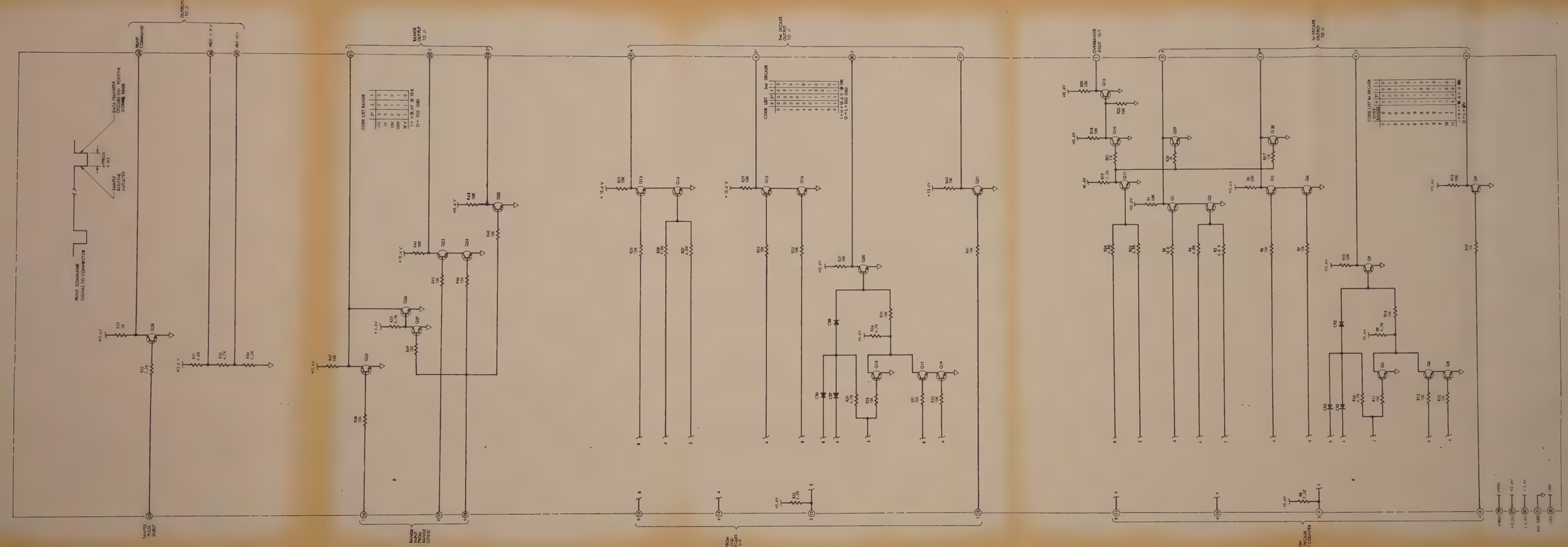

FUNCTIONAL BLOCK DIAGRA
MODEL 9500A
RMS DIGITAL VOLTMET
9500A-1000-1
JOHN FLUKE MFG. C
P.O. Box 7428
FLUKE
A1 CALIBRATION LOGIC
A11 SAMPLE CIRCUITS
A10 CONTROL LOGIC
A9 CONTROL LOOP
A8 PRINT LOGIC
A7 RANGE LOGIC
A6 PRINT LOGIC
A5 PRINT LOGIC
A4 PRINT LOGIC
A3 REMOTE RANGE AND PRINT LOGIC
A2 REMOTE RANGE AND PRINT LOGIC
A1 FAULT DETECTOR
DC THERMOCOUPLE CURRENT ADJUST
CALIB RELAY
CONTROL LOOP GAIN & TRIM
LOOP GAIN ATTEN
VCO CLAMP
BLANKING
CALIB CLAMP
CALIB LAMP
MANUAL CALIB
VERNIER
DISPLAY TIME = SEC
SAMPLE PULSE GEN.
CALIBRATE LAMP
SAMPLE LAMP
REMOTE CAL
REMOTE SAMPLE PULSE
REMOTE SAMPLE RANGE
REMOTE CONTROL INPUTS
PRINT COMMAND
SAMPLE
CLOCK
CARRY
PRECARRY
DECIMAL POINT
RANGE OUTPUTS
REMOTE RANGE INPUTS
LOGIC GND
CHASSIS GND
+15 EV
-15 EV
1V RANGE
3V RANGE
10V RANGE
30V RANGE
100V RANGE
300V RANGE
1KV RANGE
FB2
AUTO
REMOTE
SAMPLE
+100V
-100V
+10V
-10V
+2V
-2V


AC POWER SWITCH PUSH ON-OFF
POWER INDICATOR LAMP
INSIDE CHASSIS
TRANSFORMER T1
A1 POWER SUPPLY A
A2 POWER SUPPLY B
Q1
Q2
C1
MANUAL CALIB. SWITCH
SAMPLE LAMP
CALIB LAMP B (WHT/RED)
CALIB. LAMP
RANGE SWITCH
SAMPLE SWITCH
OUTER CHASSIS (CASE POINT (LT GRN)
PANEL (GRD) SWITCH
INNER CHASSIS (CABLE TERMINAL) (BLK)
RANGE SW A (WHT/BLK)
RANGE SW B (WHT/BRN)
RANGE SW C (WHT/RED)
RANGE SW D (WHT/ORN)
RANGE SW E (WHT/YEL)
JUMPER NORMALLY INSTALLED FROM A3-28 TO A3-30. REMOVE JUMPER IF A3 OPTION BOARD IS USED
A1 REMOTE RANGE AND PRINT LOGIC
A4 PRINT LOGIC 12
A5 RANGE
A6 1st DECADE 0-11
A7 2nd DECADE 0-9
A8 3rd DECADE 0-9
A9 4th DECADE 0-9
A10 CONTROL LOGIC
A11 CALIBRATION LOGIC
A12 SAMPLE CIRCUIT
A13 ANALOG FEEDBACK
A14 ANALOG AMPLIFIER
A15 NULL DETECTOR
WIRING DIAGRAM
MODEL 9500A
RMS DIGITAL VOLTMETER
9500A-1000-3



FUNCTIONAL SCHEMATIC DIAGRAM	
POWER SUPPLY	
9500A-1001	MODULES A1 & A2
MODEL 9500A RMS DIGITAL VOLTMETER	Ω
SER NO. 121 & ON	
FLUKE	JOHN FLUKE MFG. CO., INC. P.O. Box 7428 Seattle, Washington 98133


3RD DECADE OUTPUTS TO J1
4TH DECADE OUTPUTS TO J1
CODE LIST
3RD & 4TH DECADES
4 2A 2 1
0 0 0 0 0
1 0 0 0 1
2 0 0 1 0
3 0 0 1 1
4 0 1 0 0
5 0 1 0 1
6 0 1 1 0
7 0 1 1 1
8 1 0 0 0
9 1 0 0 1
1 = +4 = +3 V @ 10 K
0 = 1 = 0 V
TO RANGE SWITCH S2
NOTES
ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE NOTED
ALL CAPACITANCES ARE IN uF UNLESS OTHERWISE NOTED
AUTO
.1V
1V
10V
100V
FROM 3RD DECADE S1
FROM 4TH DECADE S1
REMOTE RANGE INPUTS FROM J1
+3.2 V
+3 V
SIG GND
-15 V
FUNCTIONAL SCHEMATIC DIAGRAM
REMOTE RANGE & PRINT LOGIC
(4221 CODE)
9500A 1003 MODULE A3
MODEL 9500A RMS DIGITAL VOLTMETER
SERIAL NO. 331 & ON
FLUKE JOHN FLUKE MFG CO., INC.
P.O. Box 7428 Seattle, Wash. 98133

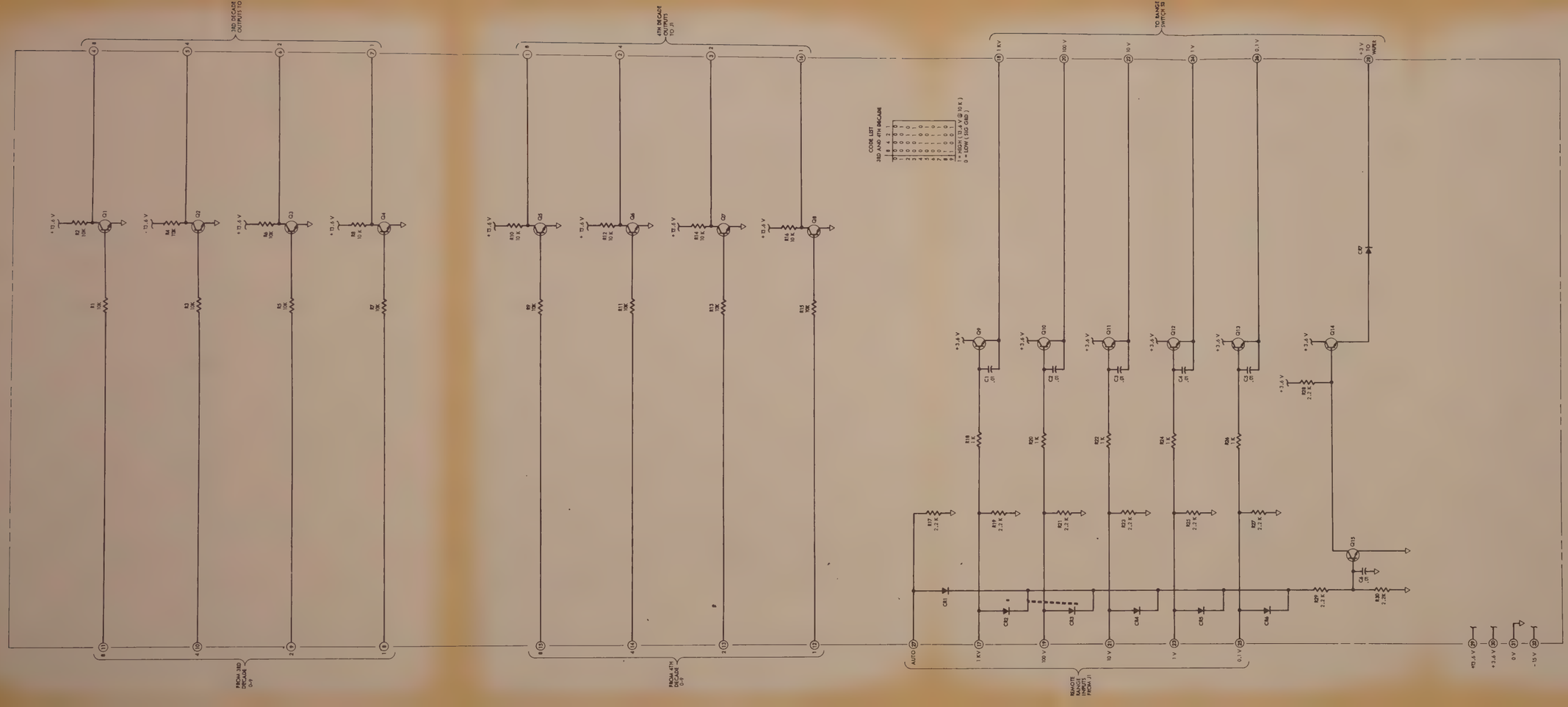


NOTES

ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE NOTED

ALL CAPACITANCES ARE IN uf UNLESS OTHERWISE NOTED

FUNCTIONAL SCHEMATIC DIAGRAM	
PRINT LOGIC (4221 CODE)	
9500A-1004	MODULE A4
MODEL 9500A RMS DIGITAL VOLTMETER	
SER. NO. 33 & ON	
FLUKE JOHN FLUKE MFG. CO., INC. P.O. Box 7428	



FUNCTIONAL SCHEMATIC DIAGRAM

REMOTE RANGE & PRINT LOGIC

(8421 CODE)

9500A-1021 MODULE A3

MODEL 9500A RMS DIGITAL VOLTMETER

SER NO 121 & On

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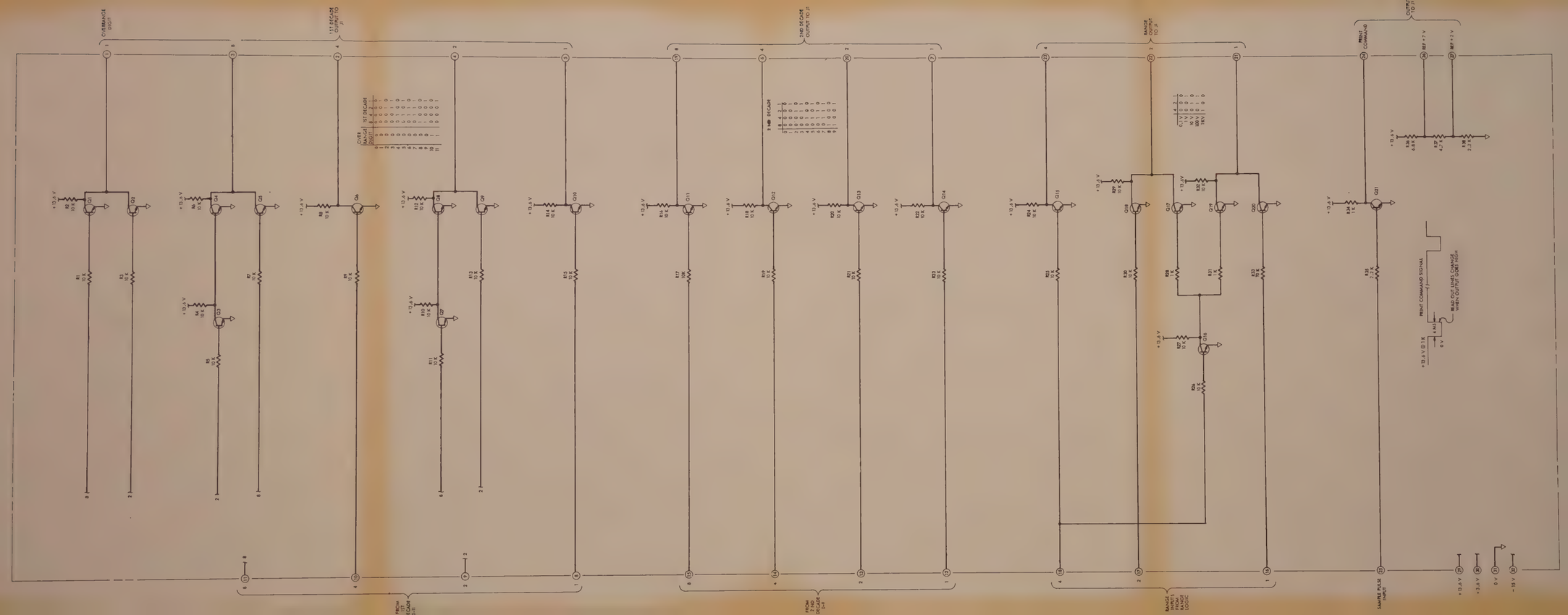

NOTES

ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE NOTED

ALL CAPACITANCES ARE IN μF UNLESS OTHERWISE NOTED

FUNCTIONAL SCHEMATIC DIAGRAM

PRINT LOGIC (8421 CODE)

(8421 CODE)

9500A-1022 MODULE A4

MODEL 9500A RMS DIGITAL VOLTMETER b

SEE MD 733 & ON

FLUKE JOHN FLUKE MFG. CO., INC
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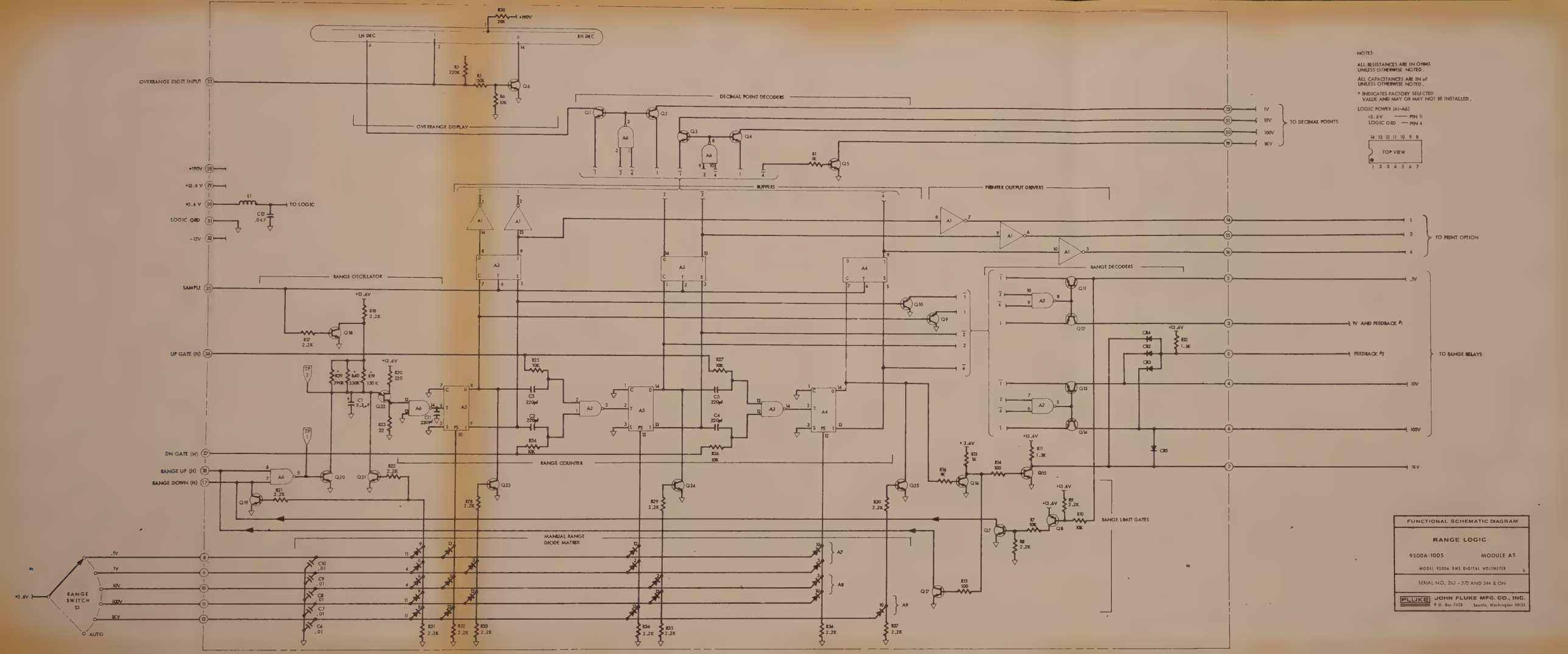
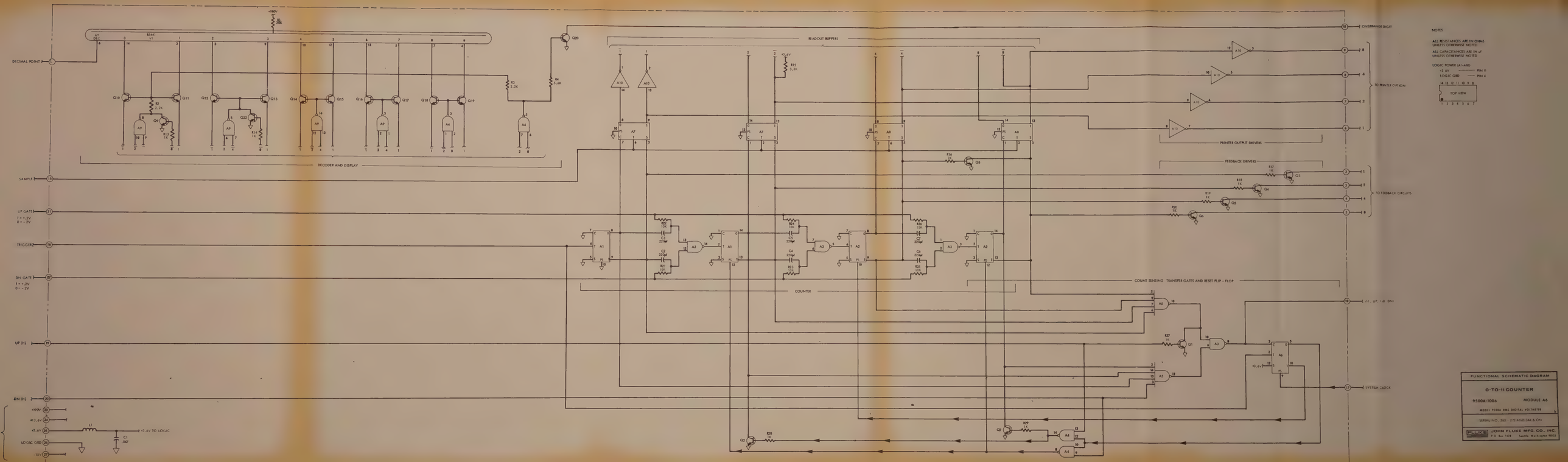
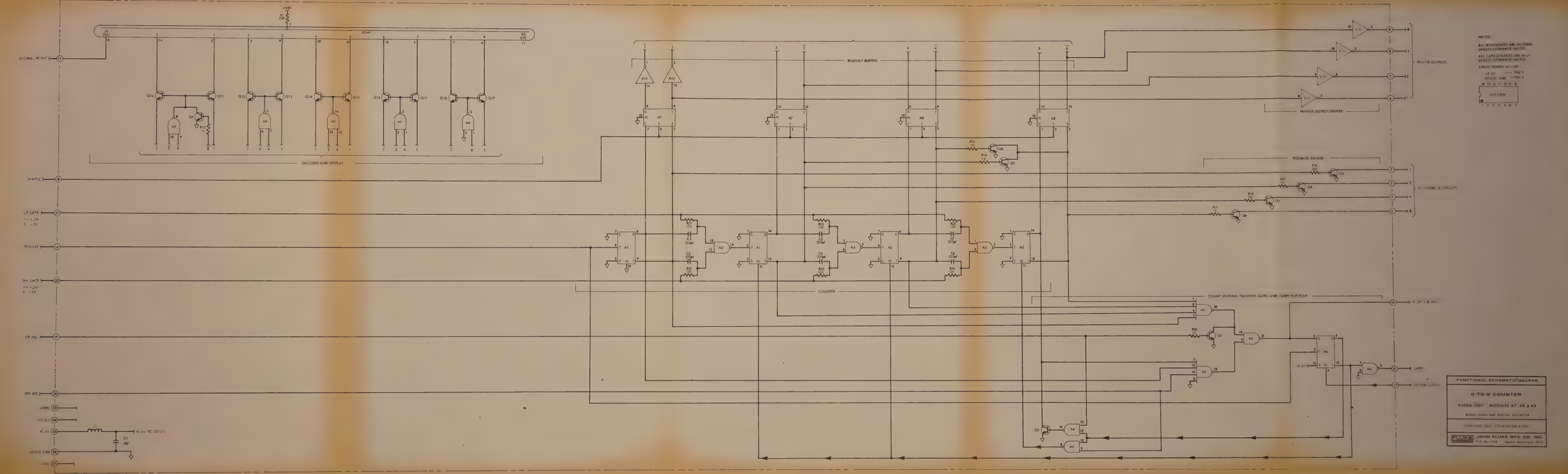

NOTES:
ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE NOTED.
ALL CAPACITANCES ARE IN mf UNLESS OTHERWISE NOTED.
* INDICATES FACTORY SELECTED VALUE AND MAY OR MAY NOT BE INSTALLED.
LOGIC POWER (A1-A6)
+3.6V — PIN 11
LOGIC GRD — PIN 4
TOP VIEW
OVERRANGE DIGIT INPUT
OVERRANGE DISPLAY
DECIMAL POINT DECODERS
TO DECIMAL POINTS
BUFFERS
PRINTER OUTPUT DRIVERS
TO PRINT OPTION
RANGE OSCILLATOR
RANGE DECODERS
SAMPLE
UP GATE (H)
DN GATE (H)
RANGE UP (H)
RANGE DOWN (H)
RANGE COUNTER
TO LOGIC
+190V
+13.6 V
+3.6 V
LOGIC GRD
-15V
FEEDBACK #1
FEEDBACK #2
TO RANGE RELAYS
RANGE LIMIT GATES
MANUAL RANGE DIODE MATRIX
RANGE SWITCH S3
AUTO
FUNCTIONAL SCHEMATIC DIAGRAM
RANGE LOGIC
9500A-1005
MODULE A5
MODEL 9500A RMS DIGITAL VOLTMETER
SERIAL NO. 263 - 272 AND 344 & ON
FLUKE
JOHN FLUKE MFG. CO., INC.
P.O. Box 7428 Seattle, Washington 98133


DECIMAL POINT
SAMPLE
UP GATE
DN GATE
TRIGGER
UP (H)
DN (H)
+190V
+13.6V
+3.6V
LO GAC GRD
-15V
+3.6V TO LOGIC
DECODER AND DISPLAY
READOUT BUFFERS
COUNTER
COUNT SENSING TRANSFER GATES AND RESET FLIP - FLOP
PRINTER OUTPUT DRIVERS
FEEDBACK DRIVERS
TO PRINTER OPTION
TO FEEDBACK CIRCUITS
OVERRANGE DIGIT
SYSTEM CLOCK
TOP VIEW
NOTES
ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE NOTED
ALL CAPACITANCES ARE IN μF UNLESS OTHERWISE NOTED
LOGIC POWER (A1-A10)
+3.6V — PIN 11
LOGIC GRD — PIN 4
FUNCTIONAL SCHEMATIC DIAGRAM
0-TO-11 COUNTER
9500A-1006
MODULE A6
MODEL 9500A DMS DIGITAL VOLTMETER
SERIAL NO. 263 - 270 AND 344 & ON
JOHN FLUKE MFG. CO., INC.
P O Box 7428 Seattle Washington 98133



NOTES:

ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE NOTED

ALL CAPACITANCES ARE IN μf UNLESS OTHERWISE NOTED

LOGIC POWER: A1 - A9

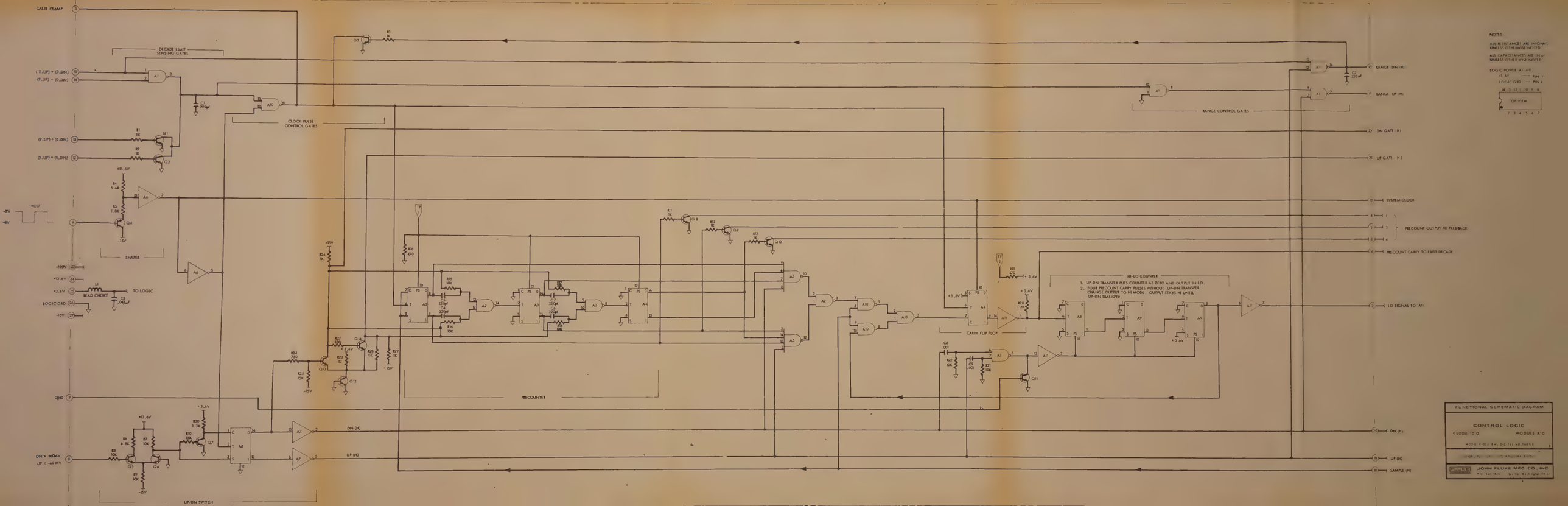
+5.6V —— PIN 11
LOGIC GRD —— PIN 4

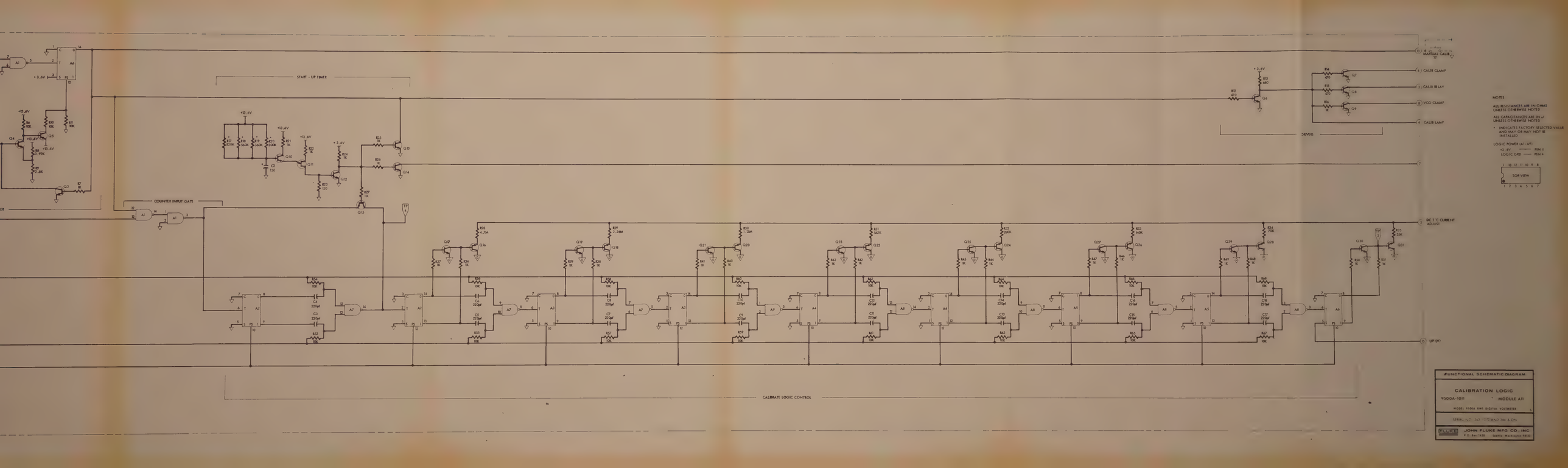
14 13 12 11 10 9 8

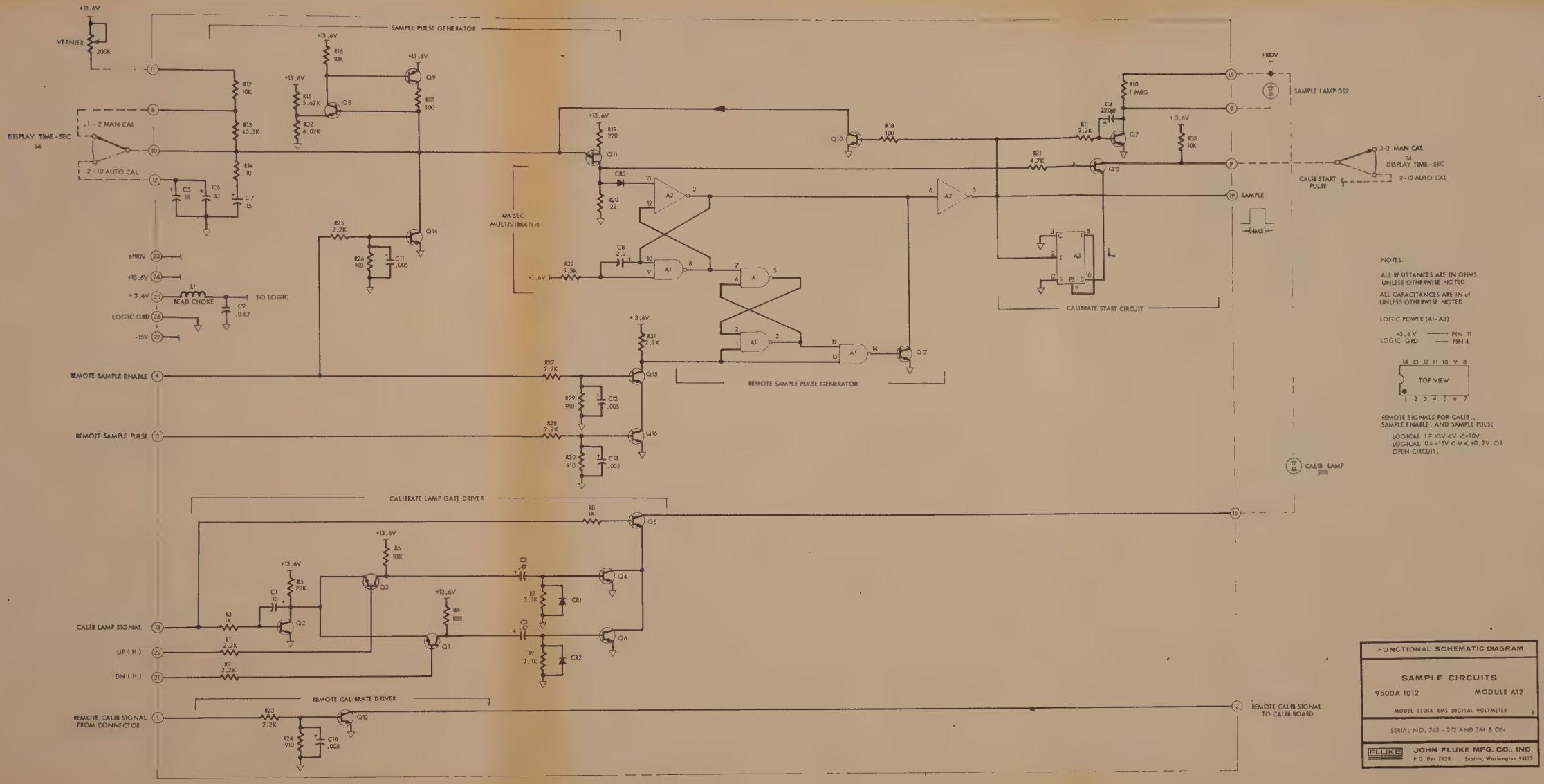
TOP VIEW

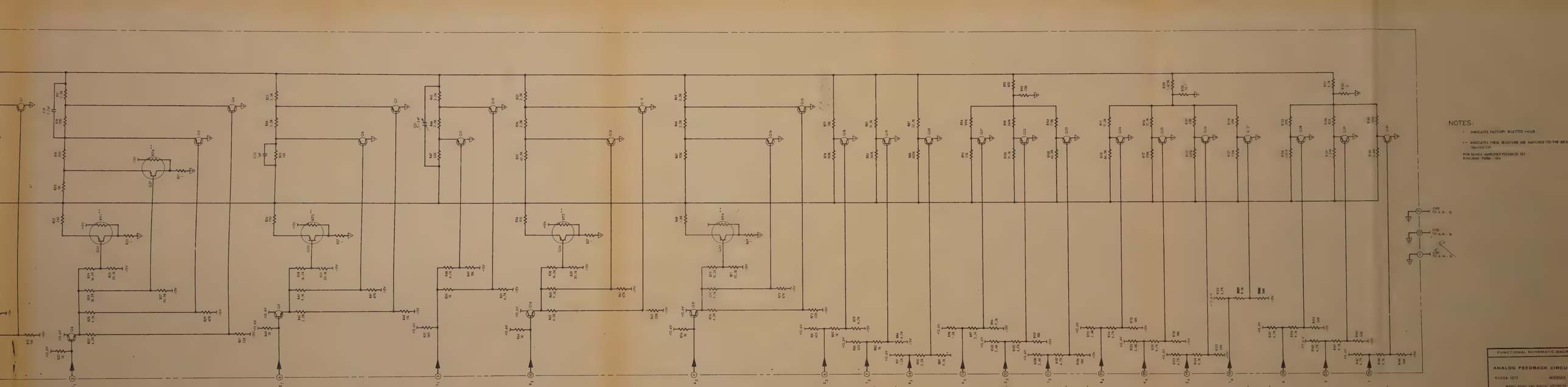
1 2 3 4 5 6 7

FUNCTIONAL SCHEMATIC DIAGRAM	
0-TO-9 COUNTER	
9500A-7007 MODULES A7, A8 & A9	
MODEL 5100A RMS DIGITAL VOLTMETER	
SERIAL NO. 260 - 370 AND 384 & ON	
FLUKE	JOHN FLUKE MFG. CO., INC. P.O. Box 7428 Seattle, Washington 98133


CALIB CLAMP
DECADE LIMIT SENSING GATES
CLOCK PULSE CONTROL GATES
RANGE CONTROL GATES
SHAPER
PRECOUNTER
CARRY FLIP FLOP
HI-LO COUNTER
1. UP-DN TRANSFER PUTS COUNTER AT ZERO AND OUTPUT IN LO.
2. FOUR PRECOUNT CARRY PULSES WITHOUT UP-DN TRANSFER CHANGE OUTPUT TO HI MODE. OUTPUT STAYS HI UNTIL UP-DN TRANSFER
UP/DN SWITCH
BEAD CHOKE
TO LOGIC
LOGIC GND
DN (H)
UP (H)
SAMPLE (H)
RANGE DN (H)
RANGE UP (H)
DN GATE (H)
UP GATE (H)
SYSTEM CLOCK
PRECOUNT OUTPUT TO FEEDBACK
PRECOUNT CARRY TO FIRST DECADE
LO SIGNAL TO A11
NOTES:
ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE NOTED
ALL CAPACITANCES ARE IN uf UNLESS OTHERWISE NOTED
LOGIC POWER: A1-A11:
+3.4V ——— PIN 11
LOGIC GND ——— PIN 4
TOP VIEW
FUNCTIONAL SCHEMATIC DIAGRAM
CONTROL LOGIC
9500A 1010
MODULE A10
JOHN FLUKE MFG CO., INC
P.O. Box 7428
Seattle, Washington 98133


START - UP TRACE
COUNTER INPUT GATE
CALIBRATE LOGIC CONTROL
DRIVERS
A-D MANUAL CALIB
CALIB CLAMP
CALIB RELAY
VCO CLAMP
CALIB LAMP
DC I°C CURRENT ADJUST
UP (H)
NOTES
ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE NOTED
ALL CAPACITANCES ARE IN uf UNLESS OTHERWISE NOTED
* INDICATES FACTORY SELECTED VALUE AND MAY OR MAY NOT BE INSTALLED
LOGIC POWER (A1-A9)
+3.6V ——— PIN 11
LOGIC GRD ——— PIN 4
TOP VIEW
FUNCTIONAL SCHEMATIC DIAGRAM
CALIBRATION LOGIC
9500A-1011 MODULE A11
MODEL 9100A RMS DIGITAL VOLTMETER
JOHN FLUKE MFG CO., INC
P.O. Box 7428 Seattle, Washington 98133


SAMPLE PULSE GENERATOR
VERNIER
200K
DISPLAY TIME-SEC
S4
.1-2 MAN CAL
2-10 AUTO CAL
4M SEC MULTIVIBRATOR
REMOTE SAMPLE ENABLE
REMOTE SAMPLE PULSE
REMOTE SAMPLE PULSE GENERATOR
CALIBRATE START CIRCUIT
SAMPLE LAMP DS2
CALIB START PULSE
SAMPLE
4MS
TO LOGIC
BEAD CHOKE
LOGIC GRD
CALIB LAMP
CALIBRATE LAMP GATE DRIVER
CALIB LAMP SIGNAL
UP (H)
DN (H)
REMOTE CALIBRATE DRIVER
REMOTE CALIB SIGNAL FROM CONNECTOR
REMOTE CALIB SIGNAL TO CALIB BOARD
NOTES.
ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE NOTED
ALL CAPACITANCES ARE IN uf UNLESS OTHERWISE NOTED
LOGIC POWER (A1-A3)
+3.6V — PIN 11
LOGIC GRD — PIN 4
TOP VIEW
REMOTE SIGNALS FOR CALIB., SAMPLE ENABLE, AND SAMPLE PULSE
LOGICAL 1 = +3V < V < +20V
LOGICAL 0 = -15V < V < +0.2V OR OPEN CIRCUIT.
FUNCTIONAL SCHEMATIC DIAGRAM
SAMPLE CIRCUITS
9500A-1012
MODULE A12
MODEL 9500A RMS DIGITAL VOLTMETER
SERIAL NO. 263 - 272 AND 344 & ON
JOHN FLUKE MFG. CO., INC.
P O Box 7428 Seattle, Washington 98133


NOTES:
• INDICATES FACTORY SELECTED VALUE
•• INDICATES THESE RESISTORS ARE MATCHED TO THE ADJ TRANSISTOR
FOR RANGE AMPLIFIER FEEDBACK SEE DIAGRAM 9500A-1004
GRD TO A 14 - 12
GRD TO A 14 - 14
-15V TO A 14 - 10
1ST DECADE (A1)
2ND DECADE (A1)
3RD DECADE (A1)
4TH DECADE (A1)
PRECOUNTER DECADE (A1)

FUNCTIONAL SCHEMATIC DIAGR

ANALOG FEEDBACK CIRCU

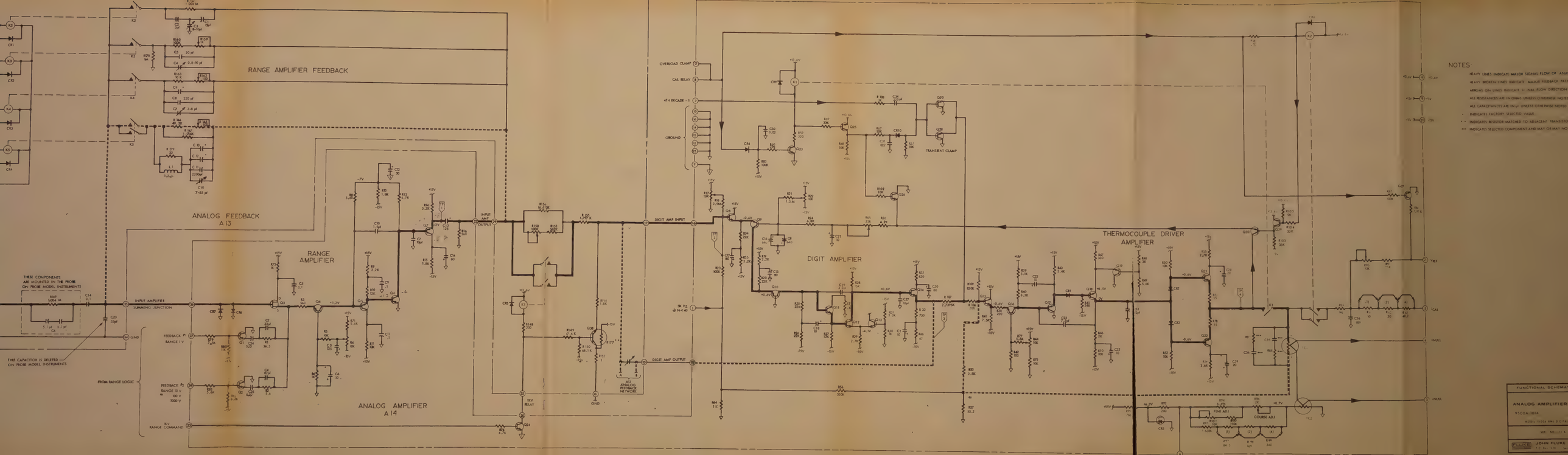
9500A-1013 MODULE

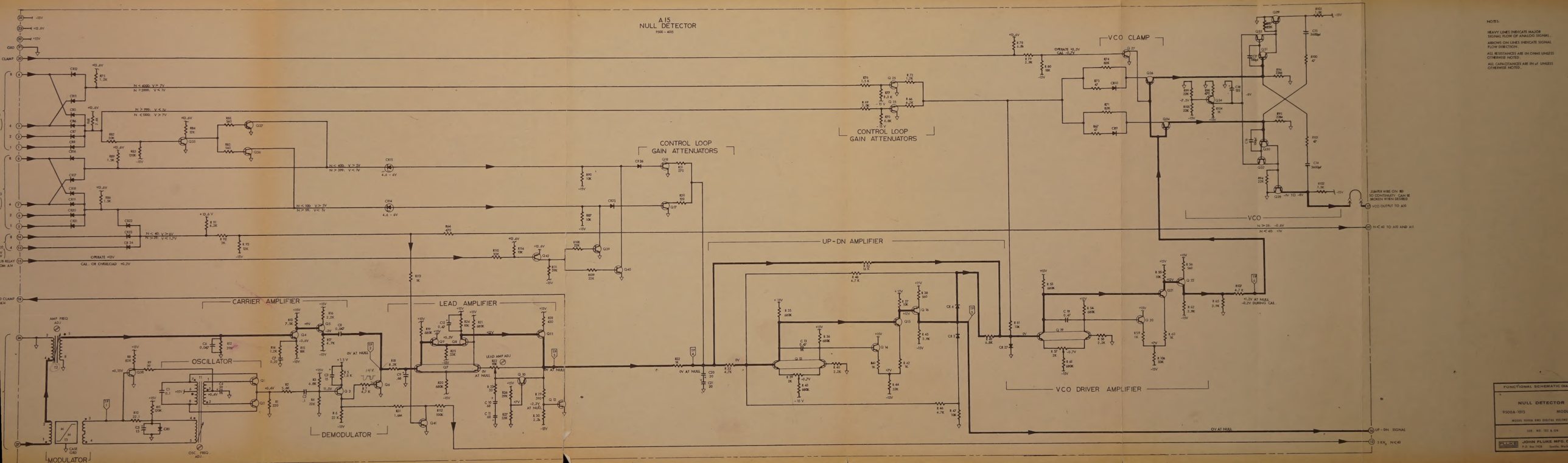
MODEL 9500A RMS DIGITAL VOLTMETER

SEE NOTICE ON

JOHN FLUKE MFG. CO.

P.O. Box 7428 Seattle, Washington


RANGE AMPLIFIER FEEDBACK
ANALOG FEEDBACK
A13
RANGE
AMPLIFIER
DIGIT AMPLIFIER
THERMOCOUPLE DRIVER
AMPLIFIER
ANALOG AMPLIFIER
A14
THESE COMPONENTS
ARE MOUNTED ON THE PROBE
ON PROBE MODEL INSTRUMENTS
THIS CAPACITOR IS DELETED
ON PROBE MODEL INSTRUMENTS
FROM RANGE LOGIC
INPUT AMPLIFIER
SUMMING JUNCTION
INPUT
AMP
OUTPUT
DIGIT AMP INPUT
DIGIT AMP OUTPUT
OVERLOAD CLAMP
CAL RELAY
4TH DECADE - 1
GROUND
TRANSIENT CLAMP
FINE ADJ
COURSE ADJ
NOTES
HEAVY LINES INDICATE MAJOR SIGNAL FLOW OF ANA
HEAVY BROKEN LINES INDICATE MAJOR FEEDBACK PA
ARROWS ON LINES INDICATE SIGNAL FLOW DIRECTION
ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE NOTED
ALL CAPACITANCES ARE IN µF UNLESS OTHERWISE NOTED
• INDICATES FACTORY SELECTED VALUE
•• INDICATES RESISTOR MATCHED TO ADJACENT TRANSISTO
••• INDICATES SELECTED COMPONENT AND MAY OR MAY NO
FUNCTIONAL SCHEMA
ANALOG AMPLIFIER
9100A-1014
JOHN FLUKE


A15
NULL DETECTOR
9100 - 4010
CARRIER AMPLIFIER
LEAD AMPLIFIER
OSCILLATOR
DEMODULATOR
MODULATOR
CONTROL LOOP GAIN ATTENUATORS
UP-DN AMPLIFIER
VCO CLAMP
VCO
VCO DRIVER AMPLIFIER
OPERATE +15V
CAL OR OVERLOAD +0.2V
OPERATE +2.5V
CAL -0.2V
0V AT NULL
-0.2V AT NULL
-0.2V DURING CAL
VCO OUTPUT TO A16
UP-DN SIGNAL
N<40 TO A10 AND A11
JUMPER WIRE ON BD TO CONTINUITY CAN BE BROKEN WHEN DESIRED
NOTES:
HEAVY LINES INDICATE MAJOR SIGNAL FLOW OF ANALOG SIGNAL
ARROWS ON LINES INDICATE SIGNAL FLOW DIRECTION
ALL RESISTANCES ARE IN OHMS UNLESS OTHERWISE NOTED
ALL CAPACITANCES ARE IN mf UNLESS OTHERWISE NOTED.
FUNCTIONAL SCHEMATIC DIA
NULL DETECTOR
9500A-1015
MODU
SEE MD 103 & 104
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P.O. Box 7428

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